Concrete

Vol. 23 *Detroit, October, 1923* *No. 4*

Permanent Color for Roof Tile

COLORS that appear to fade in concrete roof tile present a problem to manufacturers of this product. That is the reason the American Concrete Institute has organized a committee designated as P-8, on Concrete Roof Tile, P. J. Freeman, Pittsburgh, chairman, which is going to make a study of the color problem chiefly in connection with roof tile manufacture. It has been discovered that what some manufacturers have attributed to faulty colors has not been fading of the color at all but has been a removal of the film of both cement and color from the surface of the tile by mechanical action—rain and frost.

The trouble is usually that a mixture is made of cement and color and this is placed on tile in a film only. So much color is used to a given amount of cement that the binding qualities of the cement are greatly weakened; not only that, but the curing of the surface is not done very well. With such adulteration of the cement extra long careful curing is necessary. A remedy has been tried in making the color film of cement, *sand* and color, thus giving a body to the color facing. There are at least three other possible remedies: (*1*) Use good quality color with high coloring value in a facing mixture of appreciable thickness, as in making concrete building units. (*2*) Color the tile all the way through. (*3*) Obtain color by means of colored aggregates.

Then there is another entirely different line of escape from the present trouble: Educate the market to softer, less intense colors in roofing units. This would be less difficult perhaps than some might imagine. The original concrete roof tile were made to look like the red, burned clay tile, and a bright red tile does not by any means make the most beautiful roof. A strong red was believed necessary. In making green tile the same result, an intense color, was sought. On the other hand, the best looking concrete tile roof the writer has seen was laid with tile of many colors in soft tones. One of the asbestos-cement shingles on the market which has proved itself an aristocrat for fine color effect is in comparatively soft tones. An attractive feature of a new brand of copper roofing is in the soft weathered tones. Slate roofs at their best are in varied colors, none of them bright. Some of the best slate-surfaced asphalt shingles are now advertised extensively for their multi-color effects. Multi-color roofs of stained wood shingles are having a popularity based on these various color mixtures as laid on the roof.

Isn't it the part of wisdom for concrete roof tile manufacturers who really want to make permanently satisfactory roofs to do a little experimenting with strong colors in *small percentages, all the way through the tile*, producing units in varied soft tones? Roofs of such units will always look well, even should some small loss of color take place, as loss of color does in time take place in almost everything that is colored.

* * *

Specialized Organizations and Others

ORGANIZATIONS are usually successful in proportion as their purposes and activities are clear cut and have not only a direct but an *obviously* direct bearing upon the interests of a large number. An immediate objective, a rally point, provides an incentive.

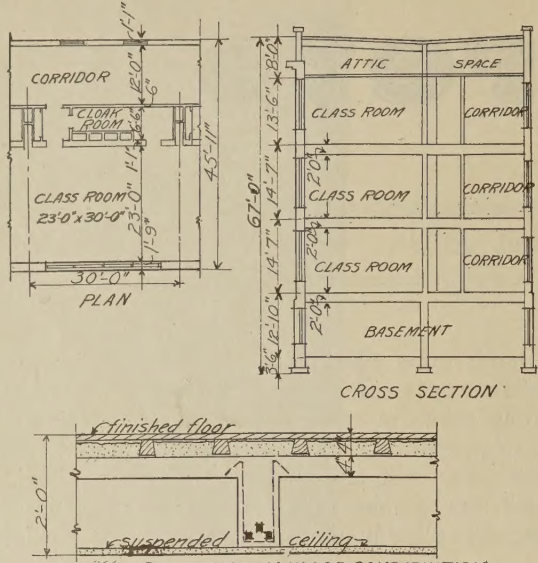
Complaint is often made of the number and variety of organizations. The number and variety continue to grow because in relatively small groups, the immediate objectives are more readily discovered. A man on a mountain top may see plainly enough that many organizations are working in the same direction and will eventually come out of the thicket at the same place but it is too much to expect those in the thicket to have the same vision.

It is to be wondered therefore if organizations whose field is extremely wide can make satisfactory progress. The objectives are of necessity more remote than the objectives of organizations whose field is compact, specialized. The achievements of the broad organizations must rest with a few whose vision is broad and who are not impatient of immediate results. Paradoxically, the specialized organization can rally more workers. More of its members can be given definite tasks. It is the definite task that finds support. The average of human interest and attention is arrested, focused and put to work more by the means to an end than by the end itself.

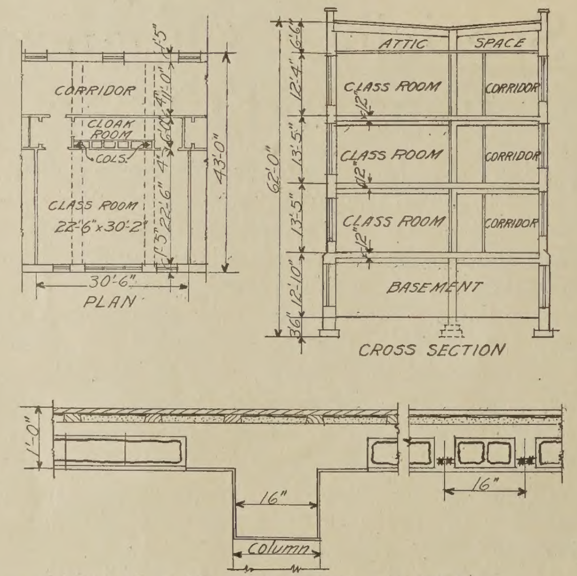
* * *

Form Costs

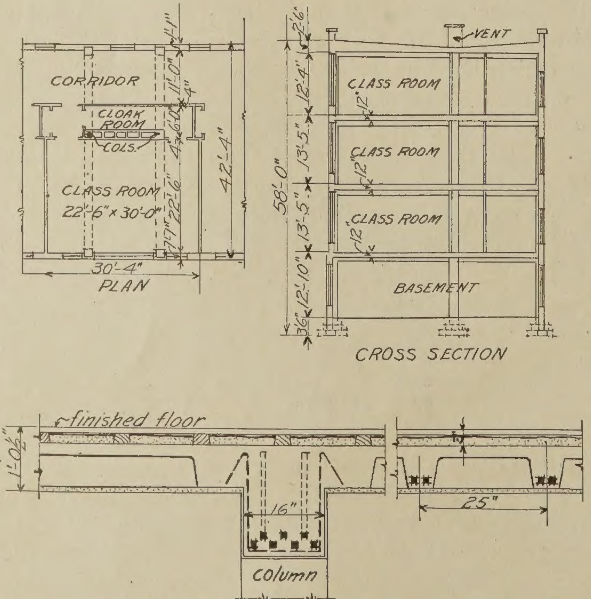
PROGRESS in construction skill is clearly evident in the statement of a New England contractor doing a great deal of reinforced concrete building construction, that fifteen years ago when labor could be had at 30c per hour the cost of forms per square foot was 2½ to 2⅔c and that this last summer with labor for the same work at $1.10 per hour the form cost (flat slab forms complete) is still 2½ to 2⅔c.



DETAIL OF CLASS ROOM FLOOR CONSTRUCTION
FIG. 1



DETAIL OF CLASS ROOM FLOOR CONSTRUCTION
FIG. 2



DETAIL OF CLASS ROOM FLOOR CONSTRUCTION
FIG. 3

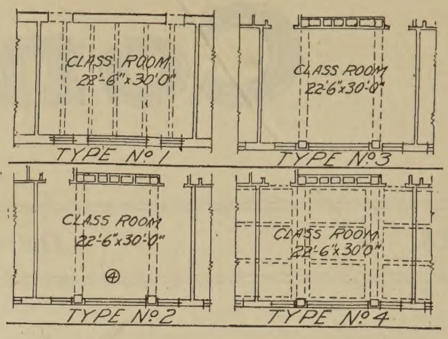


Fig. 4—Four Types of Floor Framing

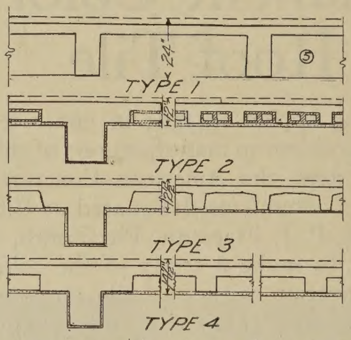
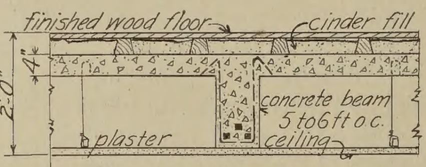
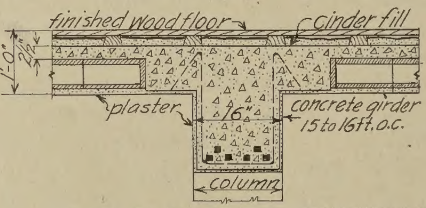


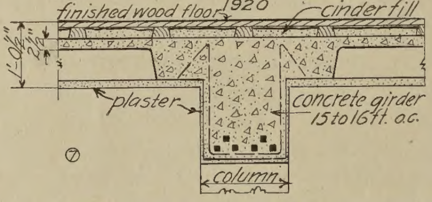
Fig. 5—Four Types of Concrete Floor Construction. Cost Comparison Shown in Fig. 7, Page 135



BEAM & SLAB CONSTRUCTION
1916



COMPOSITE FLOOR CONST.-HOLLOW CLAY TILE
1920



COMPOSITE FLOOR CONST. - STEEL TILE
1921

Fig. 6—Details of Three Types of Floor Construction Used in 1916, 1920 and 1921

Progressive Economy in Philadelphia Concrete School House Design —See Page 135

(Figs. 1, 2 and 3 at Left)

Fig. 1—Reinforced Concrete Slab and Beam Supported by Interior and Exterior Walls. The Type Used in the Oliver Wendell Holmes School in 1916

Fig. 2—Light Slab on Concrete Beams and Girders. Supported by Concrete Columns and Brick Bearing Walls. Type Used in the William T. Tilden School in 1920

Fig. 3—Type of Construction Having All Loads Carried by Concrete Columns and Girders

Cost of Reinforced Concrete for Lighter Use Buildings

The design of industrial, heavy use and heavy load buildings has been very largely in the hands of engineers rather than of architects. It is often said even by some of the progressive architects of their own profession that the architect is more hampered by the burdens of tradition than is the engineer. The engineer, thinking more in terms of modern use than of traditional form, adopts and adapts the materials and methods which most directly contribute to the end sought without too deep a veneration for the materials and methods of the last hundred years.

That is why reinforced concrete is so widely used in engineering structures.

School buildings, hospitals, asylums, hotels, apartments and office structures are the creation very largely of architects, and the development of the lighter reinforced concrete construction suitable for such buildings has lagged behind, chiefly because the men who put these buildings on paper have not been thinking in the most progressive building terms.

Here and there a brave spirit in the architectural profession is out blazing a new trail—the others will of course follow because economic pressure is insistent. If two eastern architectural firms whose boards are filled a good deal of the time with big hotel projects launch into reinforced concrete frame construction for its economic efficiency and lower first cost, for hotels, as CONCRETE understands they are very likely to do, others who design similar buildings cannot stay very far behind because their clients, the hotel financiers, are crass and want the most and best buildings for the least cost.

Then, too, bids are not infrequently taken for reinforced concrete construction when the designs upon which the bids are based are archaic—designs thought out in the structural language of heavy masonry bearing walls, impossibly massive floors, heavy steel members to take the loads and encased in concrete. Such designs do not make adequate use of present day knowledge of materials.

There is no mystery in the fact that some architects and structural engineers are able to design buildings of skeleton reinforced concrete construction that cost no more than similar buildings of so-called ordinary construction, consisting of wood joist floors and wooden partitions supported on exterior and interior masonry bearing walls. The successful designer of fireproof construction forgets the old ways of doing things and adjusts his methods to the requirements of the newer building materials, many of which have been developed primarily as fire resistants.

By making use of a reinforced concrete structural frame to carry all the loads to which the building is subjected he is able to eliminate heavy exterior masonry walls. He can eliminate 12-in. interior masonry bearing walls and substitute in their place lighter walls of hollow tile or hollow concrete partition block three or four inches thick. He will use metal lath and portland cement plaster partitions or light partition block or tile in place of the old type of wooden partition.

In the matter of fireproof floor construction the designer who thinks in terms of ordinary construction virtually builds two floors in one, by imbedding wooden sleepers in the reinforced concrete floor slab, filling in between the sleepers with cinder concrete, then nailing wooden flooring to the sleepers. He designs the floor in this manner because it is the nearest approach to the wood joist floor, the sleepers taking the place of joists. In a word, he cannot rid his mind of the old type of wood joist floor.

The more progressive designer who really understands the principles of fireproof and fire-resistive construction selects one of the lighter types of reinforced concrete floor construction, such as concrete joists and metal cores, and applies a floor finish of cement mortar, mastic, linoleum, or other material, directly to the surface of the structural concrete. His floor is lighter and costs less than the "two-in-one" floor designed by his less progressive brother. Furthermore, he eliminates interior trim wherever possible and depends upon plaster, staining, etc., to obtain the interior effects desired.

Fireproof construction is a great study in itself. It demands new methods, peculiar to the materials used, and a new attitude on the part of the designer. Mention has already been made of the waste involved in virtually building two floors in one, a wooden floor on top of one of reinforced concrete. In a similar manner, any form of floor or bridge construction in which steel beams and girders are encased in concrete (the steel being figured to carry the entire load, the concrete acting only as fireproofing) really embodies two structures in one and is less economical than either reinforced concrete alone or structural steel alone.

The following numbered paragraphs describe instances where reinforced concrete construction was found to be as economical as so-called ordinary construction, while in one instance the cost was considerably less.

1—In an article published on page 110 of the March, 1919, issue of CONCRETE and reprinted in one of the issues of *The American Architect* in the following July, pages 26 and 27, Henry K. Holsman, Chicago architect, records that the Junius Apartments, Chicago, built of reinforced concrete skeleton construction in 1918, cost four cents per cubic foot less than a similar building erected in 1913, of ordinary construction, for the same owner. Mr. Holsman has had extensive experience in designing buildings of fireproof construction and in changing previously drawn plans from ordinary to fire-resistive construction. Mr. Holsman's article reads in part as follows:

> Some six years ago the owner of the Junius Apartments, Chicago, had a building erected along the same lines as this more recent structure. The earlier building was the same length, three stories and low basement, instead of four stories in height, finished on two sides instead of three sides, and built in the ordinary manner with brick

> exterior walls, wood joists, wood studs, etc. The units in the old building were practically the same as those of the new and were designed for the same purpose, namely, apartments.
>
> The new building is fire-resistive throughout, except that the roof is of frame construction built over a fire-resistive slab, forming the ceiling of the top story. The new building is composed of better material throughout and yet its cost per cubic foot was nearly four cents less than the cost of the old building. This was done in spite of the fact that the market price of steel was at its highest point, namely, $72.00 a ton at the mill. Reinforced concrete frame construction was used.

2—In an article in the February-March, 1920, issue of *Concrete in Architecture and Engineering*, Mr. Holsman described the Plano (Illinois) State Bank Building, of reinforced concrete throughout the entire interior. The four exterior walls are of Hydro-stone block. In that article he adds the following contribution to the subject:

> Several important conclusions have been drawn from the experience with the Plano bank. This and several other examples of more recent construction have proved beyond doubt that if reinforced concrete construction and portland cement products are used logically, carefully and consistently throughout an ordinary building, it may be made fire-proof at no greater cost than if built in the ordinary manner with wood joists, wood partitions, etc.

3—Philip Dean, formerly Commissioner of Buildings in Madison, Wis., and now a practicing architect in that city, stated in a letter dated December 1, 1921, that the city had recently obtained bids on a large fire station for which three plans were prepared. The exterior walls were of masonry construction in all plans. One plan called for reinforced concrete floor construction, another for so-called metal lumber construction, and a third for ordinary wood joist floor construction. The bids for reinforced concrete construction averaged 8% higher than for ordinary construction and 3% lower than for metal lumber. The contract was awarded for reinforced concrete. In this instance reinforced concrete construction would have made a still better showing if the exterior walls had been changed from masonry bearing walls to reinforced concrete skeleton construction, with thin curtain walls of masonry.

4—An article in the March, 1923, issue of *Catholic School Interests*, published in Oak Park, Ill., a suburb of Chicago, contains the following information concerning a school building contract in Philipsburg, N. J.:

> The question of first cost of fire-resistive construction often frightens people who may be thoroughly convinced of its economy when considered over a long period of years, when insurance rates, depreciation and repair and maintenance expenditures must be taken into account. As a matter of fact, the additional cost of fireproof construction is much less than most people imagine. Numbers of instances are on record in the form of published cost data to prove this statement, but one of the most recent and interesting cases on record comes from Philipsburg, N. J. Early in 1922 a contract was awarded to the Ochs Construction Co. of Allentown, Pa., for the erection of a school building in that city at a contract price of $113,000. The building was designed with concrete brick bearing walls, wooden partitions, wooden joist floors in the class rooms and reinforced concrete floors in the corridors. The contract price was somewhat lower than anticipated, as a result of which the city had several thousand dollars of unused funds available. Under these circumstances the architects, Ritcher and Eiler, of Reading, Pa., persuaded the board of education to ask the contractor to submit a proposal for changing the floors from wood joint construction to reinforced concrete and changing the interior partitions from ordinary wood stud partitions to clay tile. The contractor submitted the proposal requested, wherein he offered to make the proposed changes for about $6,000, a fraction over 5% of the total contract price. This proposal, it will be noticed, covered changing the partitions as well as the floors from combustible to fireproof construction. But the most surprising and regrettable part of the story remains to be told. The board of education did *not* accept the contractor's proposal, even though the necessary funds were available and reasonable figures had been submitted.

5—An interesting comparison between reinforced concrete construction and wood frame construction comes from Mitchell, S.D. Early in 1922 plans were prepared by Architect O. H. Berg, of Mitchell, for a two-story and basement building of wood frame construction, 86 x 150 ft. in plan. The first story was to be used as a furniture store and the second story for apartments. The firs floor was designed for a live load of 100 lbs. per sq. ft and the upper floor for 70 lbs. so that at some futur date the apartments might be converted into offices The architect persuaded the owners to obtain alternate bids on reinforced concrete construction throughout. They were surprised to find that the bid fo reinforced concrete was only 11% higher than for woo frame construction. The owners decided to build i reinforced concrete because of the value obtained fo the small additional cost.

6—Some very interesting data on comparative cost between reinforced concrete construction and fireproo structural steel were published in *Engineering News-Record*, April 5, 1923, in the article describing the Medical Arts Building, a 19-story reinforced concrete office building in Dallas, Tex. The structural engineer's estimate for a fireproofed structural steel frame was $75,000 higher than for a reinforced concrete frame. The total cost of the completed building was about $1,200,000.

7—*Engineering Record* of December 23, 1916, contains an article describing the 12-story reinforced concrete building in Chattanooga, Tenn. known as the Volunteer State Life Building. Alternate bids were received on six different types of construction. The contract was awarded for a reinforced concrete structural frame at $72,000, while the lowest bid on the several plans involving a fireproofed structural steel frame was $138,000.

8—In April, 1923, alternate bids were received by Ohio State University for erecting the four-story Medical Arts Building in Columbus, Ohio. The building is 145 x 109 ft. in plan. The contract was awarded to Boyajohn & Barr, of Columbus, for a reinforced concrete building, at a price $14,000 lower than the lowest bid for a fireproofed structural steel building.

9—The Philadelphia *North American* in the issue of June 12, 1922, published a valuable article under the title Philadelphia School Buildings are Considered Models," in which the complete story is told concerning the substantial economy effected in the construction of schools through the use of reinforced concrete structural frames and one of the lighter types of reinforced concrete floors. Five schools can now be built for the money that four schools formerly cost, the older structures having been built with exterior bearing walls of brick supporting floors of reinforced concrete beams and slabs. The *North American* article follows:

PHILADELPHIA SCHOOL BUILDINGS ARE CONSIDERED MODELS

> We are constructing better buildings today than ever before. Less time is required for their erection than formerly. A large part of the waste space and waste material that characterized the older structures has been eliminated.
>
> While these improvements can be noted in all classes of modern buildings, the schoolhouse best illustrates this progress. The last three or four years have witnessed a change in schoolhouse design which has placed this class of public building on a par with our monumental business structures.
>
> Buildings in which children spend the early years of their lives should embody to a high degree the features of great fire resistance, structural strength, scientific lighting, heating and ventilating and proper sanitary provisions, and the finest engineering and architectural talent available should be secured to produce such a school building at a minimum expenditure of public funds.
>
> Philadelphia's new schools have pointed the way toward the ultimate in this class of structure. The work of the architects of the Philadelphia school board has attracted nation-wide attention. Inquiries are coming in from all sections of the country asking information on Philadelphia's methods of dealing with the several phases of the problem.
>
> The board of education's architects are now designing buildings which cost 20% less in first cost than the former type. This means that five schools of the new type can be built for the same money required to erect four of the older design. This reduction of cost

was brought about through the proper utilization of building materials and resulted in a saving of the quantity of building materials required for a given structure. One great source of economy was the substitution of columns of reinforced concrete for the load-bearing brick walls of the former design. Not less than $16,000 has been saved on each 30-room schoolhouse of the new type through taking advantage of the economies of reinforced concrete columns, beams and floors.

The use of a reinforced concrete frame throughout permits a marked reduction in the size of the structure without sacrificing any of the space required for classrooms, corridors, halls, stairs and such. This reduction in size is produced through the elimination of the heavy brick walls which carry the building loads in our older schoolhouses.

The architects have effected a saving in building height through the careful design of the reinforced concrete floor and by elimination of waste attic space which was made possible by roof slabs of concrete. This saving in floor space has reduced the height of our larger schools by nine feet.

With a program the size of Philadelphia's, the time of erection is of great importance. This new design has not only saved money and space, but has caused a four months' reduction in the time required to complete a 30-room school building. One-third of a year saved on the erection of each structure to be built under the $30,000,000 Philadelphia school building program is an achievement in itself worthy of national recognition. It means the shortening of the time required to revolutionize Philadelphia's school system, and hastens the day when Philadelphia can justly claim to have the finest school buildings of any great city in the world. This notable economy in time was produced through the elimination of the heavy brick load-bearing walls in favor of the reinforced concrete frame.

The new schools are among the finest in the country. The children of the city have absolute protection from the fire hazard which has taken such an alarming toll of life and destroyed untold millions of dollars' worth of property. The city's children learn their lessons in rooms which are lighted, ventilated and heated in accordance with the best-known standards of the day. They spend the early years of their lives in surroundings which promote, as far as physical conditions can, the healthy state of mind and body conducive to the development of a high type of citizen.

The school board's architects have achieved all this within the last few years. Three of Philadelphia's new schools can be built in the time which was formerly required for the construction of two buildings. The space occupied by eight of these new buildings is the same as that required for seven of the old schools. These savings in time, space and material are reflected in a reduction in first cost, which permits the erection of five new buildings at a cost equal to that of four of the former brick-wall type.

Details in reinforced concrete building design by which these savings have been effected are shown on another page of this issue.

The foregoing paragraphs probably do not include all the published data on the subject, but they show the general trend of such comparative figures as are available. Obviously it is not often that direct comparisons are available through actual bids submitted by contractors, inasmuch as architects do not usually prepare more than one set of plans. The most important point to consider is that fireproof construction in reinforced concrete can be built as economically as ordinary construction if the designer goes into his work from the standpoint of the specialist in fireproof construction. He must use methods applicable to the materials in hand, instead of trying to make new materials conform to old ideas and methods of construction. In addition, bids must be invited from contractors and construction companies experienced in reinforced concrete.

Reinforced Concrete Most Economical in School Construction

A thorough investigation as to several mediums of structural design for school buildings has been made by the Department of Buildings, Board of Education, Philadelphia, Pa., and it was found that the most satisfactory and economical form is reinforced concrete. Philadelphia school buildings are now erected without the use of any bearing walls, the entire structure being one large frame formed of concrete, encased with brick curtain walls and trimmed with stone, permitting great acceleration in actual construction and a reduction to a minimum of the possibility of delay due to labor troubles and delivery of materials.

The use of the reinforced concrete frames has also made it possible to reduce the thickness of floor construction, which in itself has lowered the height of building as much as 36 in. with a reduction in cubical contents of the building and a corresponding lowering of cost. Also, it has made it possible to carry stairs of concrete up with the building, providing a means of travel from one floor to another during construction, which under conditions where steel stairs are used could not be made ready until too late to be of any value to the different contractors.

Some interesting data have been prepared showing comparisons between wall bearing construction and column type made from actual observation and investigation.

Three of the different types of construction investigated are shown in Figs. 1, 2 and 3. Fig. 1 represents the type of school construction built in 1916, the Oliver Wendell Holmes Public School, 55th and Chestnut Sts., Philadelphia, Pa. This type consists of reinforced concrete slab and beams, supported by interior and exterior walls. Flat ceilings formed by plaster on metal lath are suspended from the soffit of the beams. The heavy dead load of the floor and the extreme width of the building should be noted.

The gross floor area, 30 ft. x 45 ft. 11 in., is 1378 sq. ft. Of this, 50% is taken up by the net floor area of the class room, 26% by the corridor, and 24% by walls, cloak room, etc. The dead load on the floor is 108 lbs. per sq. ft. made up as follows: wood, 4 lbs.; fill, 24 lbs.; 4-in. slab, 48 lbs.; beam, 22 lbs.; plaster, 10 lbs.

Fig. 2 represents the type of school construction built in 1920, the William T. Tilden school, 70th St. and Buist Ave. This type consists of 2½-in. concrete slab, 4-in. x 6-in. joists and 6-in. x 12-in. hollow tile

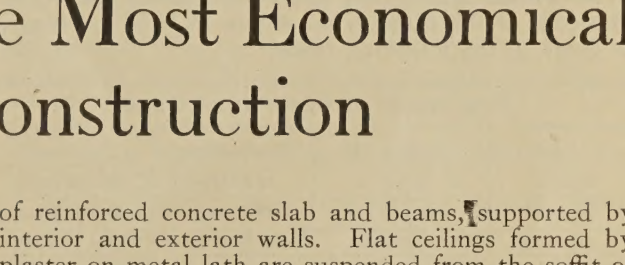


Fig. 7—Graphic Chart Showing Cost Variations for the Four Types of Floor Construction

spanning between concrete girders, supported by interior concrete columns and exterior brick bearing walls. This type of construction permits the omission of interior bearing walls, and lighter dead load. The gross floor area, 30 ft. 6 in. x 43 ft. is 1312 ft. Of this 52% is the net floor area of the class room; 26% corridor and 22% is occupied by walls, cloak room, flues, etc.

The dead load of 98 lbs. per sq. ft. is made up as follows:

Wood	4 lbs.
Fill	12 lbs.
2½-in. slabs	30 lbs.
Joists, 16 in. o. c.	19 lbs.
Tile	13 lbs.
Girder	15 lbs.
Plaster	5 lbs.
Total	98 lbs.

Fig. 3 represents a method of construction proposed in 1921. This differs from the construction shown in Fig. 2 in having all loads carried by concrete columns and girders and, also, in the omission of the attic space. This type permits light dead load of floor, estimated at 88 lbs. per sq. ft.

Of a unit 30 ft. 4 in. x 42 ft. 4 in., having a gross floor area of 1284 sq ft., 52.5% is the net floor area of class rooms, 26% the net area of the corridors and 21.5% is taken up by walls, cloak room, flues, etc.

The dead load of the floor is as follows:

Wood	4 lbs. per sq. ft.
Fill	12 lbs.
2½-in. slab	30 lbs.
Joists, 25 in. o. c.	15 lbs.
Steel tile	2 lbs.
Girder	15 lbs.
Plaster	10 lbs.
Total	88 lbs. per sq. ft.

A comparison of the gross floor areas and cubic contents of the three types shown in Figs. 1, 2 and 3 is given in the following table:

COMPARISON OF GROSS FLOOR AREAS

Types	Width of Unit	Depth of Bldg.	Total Area
Figure I	30 ft. 0 in.	45 ft. 11 in.	1377.60 sq. ft.
Figure II	30 ft. 6 in.	43 ft. 0 in.	1311.50 sq. ft.
Figure III	30 ft. 4 in.	42 ft. 4 in.	1284. sq. ft.

COMPARISON OF CUBIC CONTENTS

Types	Area	Height of Bldg.	Cubage
Figure I	1377.60	67 ft. 0 in.	92,299
Figure II	1311.50	62 ft. 0 in.	81,133
Figure III	1284	58 ft. 0 in.	74,472

An estimate of the saving in cost of the type shown in Fig. 2 as compared with the type in Fig. 1 based upon the cubic contents shows a saving in the Tilden school as compared with the Holmes school or Fig. 1, of $55,556.20 at 1920 building prices. This estimate is based upon a difference of 10,986 cu. ft. in a unit of three divisions, the cubic contents being taken from the table above. The saving in cubic feet for one division is 3,662. The saving for 30 divisions, being the estimated saving in the Tilden school compared with the Holmes school, or Fig. 1, is 109,860 cu. ft. Figuring the cost at $0.5057 per cu. ft. the estimated saving is $55, 556.20

On the same basis of cubic contents, the estimated saving in a 30-division school built according to Fig. 3, compared to the Holmes school, or Fig. 1, based upon the cost of the Tilden school, Fig. 2, is 178,270 cu. ft. which amounts to $90,151.00.

Fig. 4 shows four types of concrete floor framing. In type 1, the beams are wall bearing, and owing to the spans, the thickness of the floor construction has to be built 24 in. over all. This type was used in 1916. Type No. 2 shows slab and joist construction with clay tile fillers forming flat ceilings between large girders. The thickness of the floor construction between girders is about 12 in. This type was used in 1920. A somewhat similar arrangement is shown in type 3 used in 1922. This is a slab and joist construction with removable steel filler. After the removal of the filler, the ceiling is furred and plastered forming a flat ceiling between the large girders similar to type No. 2. Type 4 shows a 4-in. slab supported by 8-in. x 6-in. beams framing between large girders. With this type plastering may be omitted.

Details and comparison of costs for floor construction are shown in Figs. 5 and 6. In Fig. 5, type 1 shows beams spaced 5 to 6 ft. on center with a 4-in. slab. Wood forms were used throughout and the ceiling finished by furring and plastering. Type 2 shows two large girders spaced 15 ft. 2 in. o. c., with a 2½-in. slab, 4½-in x 6-in. joists spaced 16½ in. o. c. with clay tile filler, plaster applied directly on the soffit of tile and joists. Type 3 shows two large girders spaced 15 ft. 2 in. o. c. with a 2½-in. slab, 4½-in. x 6-in. joists spaced 24½-in. o. c. with 16-in. gauge removable steel filler, and furring and plastering applied to the underside of the joists. Type 4 shows two large girders spaced 15 ft. 2 in. o. c. with a 4-in. slab and 8-in. x 6-in. beams spaced 7 ft. 6 in. o. c. Wood forms were used throughout and furring and plastering applied as in type 3.

Fig. 6 shows a graphic chart of cost per class room based upon prices from reliable contractors. The advantages of type 3 are low cost, perfect alignment of joists, accessibility for inspection, minimum weight and the fact that the plastering may be omitted. Type 1 is more expensive than indicated on the chart because of the extreme depth making it necessary to use 14 ft. 7 in. floor heights.

Fig. No. 7 shows a comparison of floor construction giving details of three different types as used in 1916, 1920 and 1921.

The information showing comparisons between wall bearing construction and column type was obtained from actual observation and investigation by the structural department under the direction of Irwin N. Cathacene, architect for the school district of Philadelphia.

Our Forecast for 1924

A four billion dollar market.

Buildings of better design and better construction.

A studied elimination of cheap speculative building

The first year of real competition among manufacturers of quality building materials and equipment.

A year marking the reorganization of sales effort in the building field.

A year in which the manufacturer's total volume of business will be in direct proportion to his intelligent merchandising effort.

Finally, we predict that 1924 will be a year in which many sales and advertising managers will lose their jobs because they have failed to recognize the difference between *take* and *get* orders.—*The Architectural Forum*

It isn't so important how much you know as *how*, and how often you apply what you know.

Mr. Straphanger's House

How Cinder Block Was Introduced in Detroit

Taking advantage of the *Detroit News* homebuilding campaign, the Detroit Cinder Block & Tile Co. has got itself and its products very much on the building map of the city with orders for nearly four hundred houses to be built of Straub cinder block.

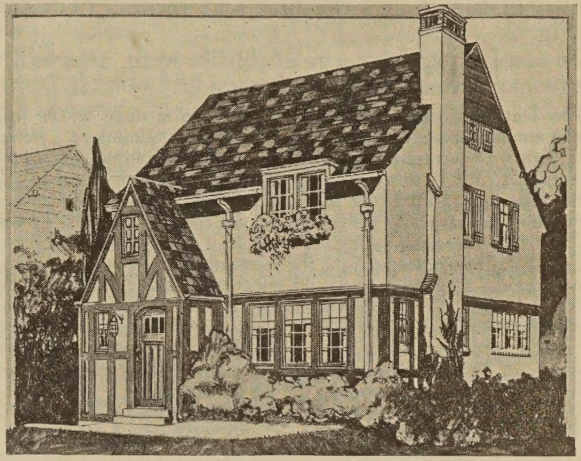
Until the *News* established a homebuilding department with Major Charles D. Kelley in charge and set about planning a home suitable for artist Thomas' cartoon characterization of the average citizen, Mr. Straphanger, there were no cinder block in Detroit and no immediate prospect of any.

Major Kelley, from force of public habit when in need of small homes, had plans drawn for a frame house. The plan was produced with the cooperation of the Michigan Chapter of the American Institute of Architects, by a committee of Detroit architects. Then Major Kelley heard of cinder block and came creditably under the influence of the movement not only for more homes but for better ones and more nearly fireproof. He went down into Pennsylvania; saw the block made and laid, the finished houses, their architects; absorbed their viewpoints—and came home sold.

He completed the process of selling himself after having block tested at Columbia University, New York, Lewis Institute, Chicago, and Perry Testing Laboratories, Detroit.

About this time William S. Piggins of the W. S. Piggins Building Corp., who had been figuring on building Mr. Straphanger's house, put in bids for cinder block wall construction and the figures ran only 5% higher than for frame.

The Detroit Cinder Block & Tile Co. was formed, with Piggins as the active head, and with no less publicity-valuable stockholders than Senator James Couzens and Ty Cobb among those who supply the $250,000 of capital for the enterprise.

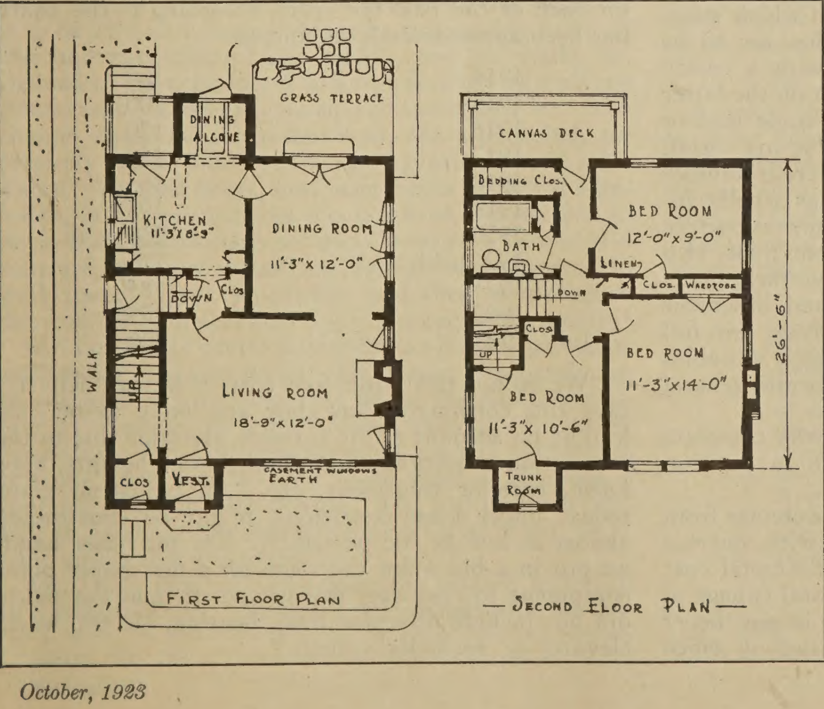


Piggins agreed to build the Straphanger house for $7000 and to duplicate the house anywhere in Detroit no less than 20 times for private home ownership at the same price per house.

Twenty won't be enough as, the *News* having arranged the matter of financing, also, through the Union Trust Co. and other very worth while institutions, there are so far about 400 applications for Straphangers' cinder block houses.

So that's how cinder block gets its start in Detroit.

The cinder block plant couldn't get under way soon enough to make block for the first of the *News* houses and the block were shipped in from Chicago. The house is up and ready for stucco and plaster, both of which,. outside and in, are to be applied direct on the block.



[It is here suspected that some confusion of thought exists as to moisture penetration and heat loss. Justifiably satisfied that moisture cannot penetrate the porous cinder block when the wall is covered with waterproof portland cement stucco, builders have perhaps assumed too readily that this same porous wall, admittedly having a high insulating value as compared with dense gravel or stone concrete block, will provide sufficient insulation without inside furring against below zero blasts which sometimes blow on Detroit in midwinter. This magazine will be glad to see tests of B. t. u. losses through cinder concrete block walls which justify the omission of furring before interior plaster is applied. Until such tests are available it feels that advice to its readers must continue to be to take the extra precaution of furring in all regions where the difference between outside and inside temperatures must be as wide as 70 degrees.

The smaller our national coal pile gets the more important is that advice. It is a very great mistake to assume that where moisture cannot go through, heat units will also be barred. The moisture that collects on the inside of window panes as on interior surfaces of solid masonry walls is not of course coming through from outside. Such moisture probably does no harm. Most dwellings don't have enough moisture in the air. Condensed moisture of that kind is not in itself a construction malady but it is a sympton of what is of more economic consequence, namely, heat loss.—*Editor*]

The *News* house as it is to look when complete is shown in Fig. 1 and the first and second floor plans in Fig. 2.

In explaining why cinder block were selected for the construction Major Kelly said:

The Detroit *News* believes it owes a definite duty to the public in the encouragement of proper community development. When a campaign was decided upon to encourage homebuilding we had three objects in mind: 1, to provide the average man with suitable plans; 2, to assist him in financing the construction; 3, to put him in touch with reliable contractors who could deliver the kind of house he wanted, at a price he could swing.

To crystallize the campaign, the *News* decided to build a house on a lot that the average man would select, plan and finance and build it exactly as the average man would want to do it. Plans for a house that could be built for around $7000 were drawn under the supervision of a committee appointed by the Michigan Chapter, American Institute of Architects. This plan called for wood frame with metal lath and stucco, and bids were secured on that basis.

Then we heard of Straub cinder blocks. We also wanted to make our campaign better by encouraging not merely the building of homes but the building of *better* homes.

We sent men out to look into Straub blocks. I examined this construction in Philadelphia. I saw Straub blocks being made in Chicago. I talked with architects, builders and owners. We became convinced that for the house we had in mind—the home of the average man—Straub blocks represented absolutely the best and most economical material.

We secured new bids on the same house, substituting Straub cinder block masonry walls for frame, exterior stucco and interior plaster to be applied direct. To our surprise the second bids ran only 5% above the first bids. In other words, the average man can get a solid masonry house, fireproof as to walls and well insulated for $7000, which is less than $400 more than he'd have to pay for a burnable wood frame house of exactly the same size and plan.

Some features of the *News* house will be tiled floors in bath and vestibule; built in tub; kitchen floor of Armstrong cork; ventilator fan in kitchen; Dutch cove breakfast nook; French doors to terrace; Creo-dipt mottled shingle roof; exterior wood trim of brown stained cypress readily nailed onto the block.

The basement walls are of 8 x 12 x 16 in. block; above grade, 8 x 8 x 16.

The Detroit Cinder Block & Tile Co. has taken over buildings and grounds at 6 mile Road and Newbern avenue; has two Multiplex machines with a Blystone mixer producing cinder block under rather laborious conditions—since crushing, screening and handling equipment and more mixers and block machines to give a production of 10,000 block a day have not yet arrived.

Cubic Foot Costs for Reinforced Concrete Buildings

Any examination into the trend of cubic foot costs for reinforced concrete buildings is fraught with difficulties. A reader of CONCRETE asked what such costs have been over a period of several years—figures by which comparison might be made with other types of construction. One contractor we put the question up to replies that asking the cubic foot cost of reinforced concrete building construction, except of a particular building, is like asking "how high is up" or "how long is a piece of string."

" For instance," he says, " a factory in which automatic screw machines, punches and lathes are to be installed may be identical in layout with a candy factory and yet the mechanical equipment on the latter will run its cost very much higher per cubic foot or per square foot. Likewise, in the structure itself, equal square footage of floor area on a different number of floors will make data on two buildings wholly incomparable. Again, a two-story and basement concrete building has four concrete slabs, basement floor, two supported floors and supported roof to give three floors of useful space; whereas, a four story and basement building has only two additional slabs, giving two full additional floors. There are a myriad such variables as this that make it hard to assemble data into general tables.

"Unless you give your readers practically complete specifications you will hardly find them in position to make much use of such data.

"On a rather large hotel just figured, the change from concrete columns and floors to steel frame with concrete fireproofing and floors will involve an additional cost for the structure of 4¼c per cu. ft. in a total cubage of 4,500,000 distributed on 14 floors. It is our belief that this will represent the difference also on office building construction. Probably, however, as stated above, these building cost data are of little value except as interpreted with the plans and specifications."

* * *

Another large contractor, however, building many large industrial plants of reinforced concrete, maintains a chart showing the cost of completed buildings, referring to 1914 as a base. The average cost index for each of the past ten years, according to the chart, has been approximately as follows:

1914	100
1915	100
1916	120
1917	150
1918	165
1919	195
1920	250
1920 peak	275
1921	185
1922	175
July, 1923	200

"We do not talk cubic foot costs if we can help it," says this contractor, "as they are likely to be misleading on account of the extreme variation due to the foundation conditions, floor loads, story heights, floor finish, exterior treatment, etc. An industrial plant today, under ideal conditions, might be constructed almost as low as 20c per cu. ft. On the other hand, we put in a bid a few days ago for a newspaper plant equipment to cost over 60c per cu. ft. and our figure did not include any plumbing, heating, electric work, elevator or sprinkler system."

Dustproof and Attractive Concrete Floors

By W. E. Hart
Manager Structural Bureau
Portland Cement Association, Chicago

Concrete floor surfaces are used on every floor, except the first, of the Drake Hotel, Chicago, opened January 1, 1921. The new nurses' home of the Augustana Hospital in Chicago, built during the winter of 1921-1922, is an 8-story building with concrete floor surfaces throughout. A new school building in Evanston, Ill., completed late in 1922, has a concrete floor surface in the corridors and other public spaces, while the classrooms have a mastic finish laid directly on the concrete. The 19-story reinforced concrete Medical Arts Building, Dallas, Tex., completed early in 1923, has terrazzo floors in the corridors, and plain concrete finish, covered with rugs, in all offices.

The foregoing are only random examples of new ideas concerning floor finishes for high-class buildings. A few years ago buildings such as these would in all probability have been provided with a hardwood floor finish, or some expensive tile finish, even though the structural parts of the floors were of reinforced concrete. They are good illustrations of the advance in construction methods and the gradual economy accomplished through adoption of more sensible methods and the overcoming of ancient prejudices.

A Prominent Architect's Experience

Mr. Irving J. Gill, a Los Angeles architect, is the author of an article published some time ago in *Sunset Magazine*, in which he tells the layman as well as his brother architects a few things about their prejudices against concrete floors.[1]

He supports his statements with facts based on his own experience. Twenty years ago, Mr. Gill said, he built a residence for himself, and partly as an experiment he built the first floor of concrete. He expected it to be cold and damp; in fact he expected it to be all the uncomfortable things people said it would be. Instead of that, he found it warm and dry and all the comfortable things people said it would not be. The charges against the concrete floor, Mr. Gill stated, are precisely those made years ago against cement sidewalks. We had come from dirt paths to board sidewalks, but it seemed like too much of a departure to jump from board walks to concrete walks. People said concrete walks were hard on the feet and tiresome to walk upon. Even physicians said they would cause flat feet. Who would now think of doing without them?

Mr. Gill has of course found similar notions prevalent concerning concrete floors. He places it squarely up to the architect to overcome these popular opinions, first by learning the truth himself, then by convincing his client. Mr. Gill sees no more logic in covering a concrete floor with a wood finish than in covering a concrete sidewalk with boards. The real problem consists in finishing the concrete floor so that it will be at once serviceable and attractive.

Mr. Gill's practice is to have the surface trowelled to a smooth finish. Mineral colors mixed with the dry cement permit him to produce any desired color effect. As a general thing, he uses combinations of red and yellow, red and brown or yellow and brown, slightly mottled. Tempered by the gray color of the cement, these colors produce neutral tones that are splendid backgrounds for rugs and furniture. When quite dry, the cement should be cleaned with a weak solution of ammonia and water, given two coats of Chinese nut oil to bring out the color, then finished with a filler and waxed like hardwood. When well done, this treatment produces an effect similar to old Spanish leather. Of course, as Mr. Gill points out, it is impossible to lay down definite rules for placing and finishing a concrete floor in such a way as to bring out all its potential beauty. Specifications and instructions carry one to a certain point, but beyond that point each builder must study out the problems for himself.

Economies Independent of Material and Labor Prices

The National Federation of Construction Industries has issued a circular discussing the results of a construction cost survey made by that organization. Concrete floors and floor finishes are mentioned as being effective in reducing construction costs. This circular states that if construction costs are to be lowered, economies must be made in large measure independent of material prices and labor rates. After pointing out that large numbers of buildings are now being built with concrete floor finishes where formerly tenants insisted on having hardwood, the statement is made that the concrete finished floor, if applied directly to the structural concrete, costs less and weighs less than the wood finished floor, while the reduction in dead weight incidentally reduces the weight and cost of columns and foundations.

Relative Cost of Various Floors

Another important contribution to the subject of concrete finished floors for structures such as hotels, large apartment buildings, office buildings and hospitals, appears in a booklet published by Oliver H. Bartine, Hospital Consultant, New York city. Mr. Bartine has arranged various floor finishes in the following order of relative first cost, the material of highest cost being named first:

1. Marble
2. Cork tile
3. Rubber tile
4. Tile (clay, ceramic, encaustic)
5. Mosaic tile
6. Slate
7. Terrazzo
8. Composition flooring
9. Wood, hard maple
10. Asphalt
11. Linoleum
12. Portland cement mortar

Terrazzo Floors

Although the ordinary portland cement mortar finish is placed lowest in first cost, terrazzo flooring is one of the most economical from the standpoint of daily cleaning and maintenance, according to Mr. Bartine. Terrazzo is in reality a concrete floor finish in which specially selected aggregates are mixed with portland cement, and is well suited to corridors and other public and semi-public spaces of large buildings.[2] Terrazzo should be laid if possible before the structural concrete base has hardened. This has the practical advantage of making the terrazzo finish monolithic with the body concrete of the floor, and most city building codes will under these conditions allow the finish coat to be considered a part of the floor thickness. On the other hand, if the terrazzo finish is placed after the concrete base has hardened, the finish coat cannot be considered as a part of the floor thickness and this additional thickness must be added to the structural concrete.

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[1] Concrete, May, 1916.

If it is known in advance that the concrete base will harden before the terrazzo finish is placed, the concrete should be left somewhat rough. Just before placing the terrazzo, the concrete base should be carefully cleaned, drenched with water and painted with a grout of neat cement of creamy consistency. Immediately thereafter, the base course of the terrazzo finish should be placed, making it 1 in. to 1¼ in. thick. Sometimes a 1:2:4 mixture of portland cement, sand and small pebbles, small stones or cinders, is used for this base or "filler" course, but a 1:3 cement and sand mortar is considered better. The sand should be clean and well graded. This base course should be tamped into place and screeded to a smooth, even surface.

The placing of the finish course is sometimes delayed 24 hours, but better results are obtained if it follows immediately after the base course is completed. The finish consists of a mixture of portland cement and marble or stone chips or screenings, to which a little sand may be added. Some architects specify definite proportions of cement and chips, such as 1:3, while others merely specify that enough cement shall be used to fill the interstices. This mixture is spread evenly to a thickness of ¾ in. and is rolled; then additional marble chips, either of the same size or a little larger, are spread over the surface and rolled in. Enough chips should be used so that they will cover at least 85% of the finished surface.

After the finish course has hardened somewhat (often at the end of 24 hours), but before it gets too hard, it should be ground down by a rotary rubbing machine, or by hand with a carborundum brick, to a smooth, even surface, thus exposing the chips.

For a white surface white marble chips may be used. By using coloring material and chips of different colors, shapes and sizes, an infinite variety of color and mosaic effects may be obtained. Borders and patterns of contrasting colors can readily be worked out by placing boards in the proper position when the main area of the floor is laid and later filling in the vacant places thus provided with a mixture of the desired color. Although much larger areas have been laid successfully it is best to lay terrazzo in areas not over 10 ft. square in order to provide properly for expansion and contraction. If the undivided areas must be larger than 10 ft. square, wire mesh or expanded metal reinforcement should be used in the base course of the terrazzo.

Portland Cement and Sand Finish

Where an ordinary concrete finish is used instead of terrazzo, mineral colors may again be used, as with the terrazzo, and as previously mentioned in connection with the work of Mr. Gill. In all cases the mineral color should be incorporated with the entire finish coat and should be mixed dry with the cement and sand. In no case should the amount of coloring matter exceed 5% of the weight of the cement used.

After the surface of the finish coat has been brought to the established grade, it should be worked with a wood float in a manner which will thoroughly compact it and provide a surface free from depressions or irregularities of any kind. When required, the surface must be steel-trowelled, but excessive working must be avoided. Under no circumstances should the architect allow the practice of sprinkling mixtures of dry cement and sand on the surface to absorb moisture or to hasten the hardening. This is almost certain to lead to dusting.

Curing the Floor

We have now arrived at one of the most important and one of the most frequently neglected phases of development in ordinary concrete floor construction as well as in cement and terrazzo finishes. This is the manner of curing. Elaborate tests carried out at the Lewis Institute Structural Materials Research Laboratory, supplemented by observations on any number of buildings actually constructed, have proved conclusively that if a concrete floor is kept moist with a layer of damp sand for ten days after the concrete finish is placed, the strength may be increased by 75% and the resistance to wear may be increased by 40% over the results attained if the floor is allowed to dry out without such protection. In very hot weather the difference is even more marked, as the extreme heat, especially if accompanied by wind, dries out the concrete so rapidly that the amount of water remaining in the material is insufficient for proper hardening.

The freshly placed material should be protected with tarpaulins during the first 24 hours, to prevent too rapid drying out by the sun and wind, and as a protection against pitting by rain drops. If the material has hardened sufficiently at the end of 24 hours it should then be covered with at least 1 in. of wet sand or 2 in. of wet sawdust. This protective covering must be kept wet by frequent sprinkling with water for at least ten days.

A notable instance of the value of proper curing of a concrete floor may be seen in the Guaranty Industrial Building in Philadelphia, occupied by the Gomery-Schwartz Motor Car Co. The concrete floors in this building were cured under a thin layer of water held on the floors by the well-known "ponding method." After the hardening had proceeded for some time, the water was removed and a solution of sodium silicate was applied, with the result that these floors today are hard and free from dust, and are standing up splendidly under particularly hard and trying wear.

Floor Hardeners

Of course in a building such as a hotel, apartment or office building, the wear is much less trying than in the case just cited. At the same time, a floor hardener such as the sodium silicate above mentioned may be well worth the cost of its application, for it is easy to apply and produces an extremely hard surface that is highly resistive to wear. Many commercial floor hardeners are on the market, many of them with years of successful service behind them. Specifications and complete instructions for placing them may be obtained from the manufacturers.

Dustproofing Concrete Floors

A concrete floor, whether finished with portland cement and sand mortar or so-called terrazzo, will give entirely satisfactory service and will be entirely free from dusting if it is properly built and allowed to harden under proper conditions. However, if the workmanship is poor or if for any other reason the floor develops dusting, the trouble may be removed by several available methods.

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[2] Specifications for terrazzo may be had from the Portland Cement Association.

One method consists in the application of several coats of sodium silicate or other floor hardener. The existing floor should be washed thoroughly with clear water and scrubbed with a stiff broom or scrubbing brush until all dirt is removed. The surface should then be allowed to dry thoroughly. One part of sodium silicate (water glass), of 40° Baumé, should then be mixed with three to four parts of water, and a coat of this solution should be brushed evenly over the entire surface. The solution will penetrate into the pores of the concrete. After the first coat is allowed to dry for 24 hours, another coat should be applied in the same manner as before, followed by a third coat after another 24 hours. If after 24 hours the third coat is not flush with the surface in all parts of the floor, a fourth coat should be applied. In a word, all the pores in the floor must be filled with the solution. That part of the solution which remains on the surface can be washed off, thus evening up the floor. The part which has penetrated into the pores has gone into combination with the alkalies and salts in the concrete and has formed an insoluble and very hard mineral glue.

Another method, very simple in its application, was used in a large building belonging to the Northwestern Bell Telephone Co., in Minneapolis. The superintendent of building for this company reports that their experience proved that by simply mopping the floors with heavy suds made from ordinary soft soap of the consistency of Noxall[3] they were able to eliminate all the dusting that had developed. In addition, this treatment gave the concrete floors a beautiful wax-like glaze. At first the mopping had to be done frequently and the suds had to be made very heavy, but in a short time a weekly mopping with soap suds of the strength used for ordinary floor cleaning kept the floors in good condition.

Newly revised tentative standard specifications for concrete floors, various types, have been issued by American Concrete Institute. These standards include notes on construction practice, making them especially valuable.

Atlantic City Housing With Concrete Block

By E. F. Brumby

Portland Cement Association

Cinder Block Were Shipped 60 Miles from Camden for the Walls of These Houses, Near Atlantic City

A housing development at Avolyn Court, Ventnor City, N. J. (a suburb of Atlantic City) indicates the wide market open to the concrete products manufacturers who make a whole hearted effort to widen their sales field.

The Concrete Specialties Co., Camden, N. J., makes cinder concrete block. While the sales of this block in Camden have been large, so that the plant output has been regularly increased, the company has been reaching afield in search of additional markets in which to popularize its product. The plant has a direct siding on the Philadelphia & Reading Railroad, and as a result of sales effort the company's product is now being shipped to Atlantic City, sixty miles distant, and practically all intervening towns. A sales agency was established in Atlantic City and a commodity freight rate obtained. Sales of block in the Atlantic City district have been very gratifying.

This method of selling is frequently overlooked by block manufacturers who are content to confine their sales efforts to the town in which their plant is located. As a result, during the off season when the demand is slack they are hard put to keep the plant running at a profitable output.

If, however, sales agencies are established within economical shipping or trucking distances of the plant and an attempt made to popularize the product for superstructures as well as foundations, the manufacturer opens for himself a sales field many times greater than he would otherwise have, and even in slack seasons he can count on a volume of business sufficiently large to keep his plant running profitably.

The present output of the Concrete Specialties Co. is at the rate of 10,000 standard block per day. The development above referred to is owned by Messrs. Banks, Nickman & Dreyfous, whose architect, Seward G. Dobbins of Atlantic City, prepared plans from which the houses were built—three of them shown in the accompanying illustrations. The builders were Johnson & Johnson of Atlantic City and the bricklayer contractor, the Unit Construction Co.

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[3] The Pure Oil Co.

Three Ways to Build Bridges in Winter

Road officials and bridge contractors need not hesitate to proceed with plans for building concrete highway bridges because of the approach of cold weather. In fact, these connecting links of improved highways may often be built to better advantage in winter than in summer, for the reason that labor and materials are both more readily available during the cold season, when work on paving highways is suspended.

Three methods are frequently used. The first consists in building the bridge under a tent or wooden inclosure, the interior of the tent or inclosure being kept warm with stoves. The second method consists in heating the aggregates and the water for the concrete and protecting the freshly placed concrete against early freezing. This method is successful when the temperature is not too low. The third method consists in not only heating the aggregates, but protecting the entire structure with manure.

One of our illustrations shows the tent under which a three-span reinforced concrete arch highway bridge was built over the Little Goose river in Sheridan county, Wyo., during the severe winter of 1919-1920. The interior of the tent was heated with stoves. The weather was extremely cold and the ground was covered practically all winter with heavy snows. The freezing of the water in the river and the frozen condition of the surrounding country eliminated all trouble from running water and sudden floods, and were consequently an actual assistance to the progress of the work. As a result, an important concrete highway was opened to early spring traffic many months sooner than would have been possible had work been postponed until the spring of 1920.

A somewhat similar method was used during the winter of 1920-1921 in building the Baugo Creek bridge on the Lincoln Highway between Elkhart and South Bend, Ind. This bridge consists of two pony truss spans and a reinforced concrete floor. The center pier and abutments were concreted in advance of cold weather, so that it was not necessary to inclose the entire bridge site as was done with the Wyoming bridge just described. The trusses were supported in their final position on false-work and a wooden inclosure very similar in appearance to an old fashioned covered wooden bridge was built of 1-in. ship-lap lumber supported on the false-work. The floor of this wooden inclosure was placed several feet below the level of the bridge floor. Thus the entire superstructure was housed in. Small windows in the sides of the wooden inclosure provided light, while heat was furnished by stoves. The bridge floor was concreted and the steel trusses were painted under these favorable conditions. The cost of the inclosure is said to have been much less than it would have cost the contractor to break up his construction plant in the fall and resume work the following spring.

During the same winter (1920-1921) a large six-span reinforced concrete arch bridge was built over the Wabash river at Attica, Ind. The spans of this structure vary from 135 to 150 ft. In the fall preceding that winter sufficient amounts of sand and gravel were stored in a stock pile to allow continuation of work all winter if necessary. The material was placed in bins having false bottoms through which steam heating coils were passed, beginning at the top and running longitudinally back and forth to the bottom where a valve was placed to drain the coils. Live steam was passed through these coils during concreting and the aggregates were kept heated. During very cold weather steam was turned on the evening before the aggregates were to be used, so that by the following morning the material was hot. The water used for mixing concrete was also heated and it was possible to place concrete so that its temperature after being in place was around 70° F.

Near Waterloo, Ia. in the winter of 1921-1922 a reinforced concrete arch railway bridge, consisting of five spans varying from 70 ft. to 74 ft. each, was built across the Cedar river. The temperature during actual concreting was as low as 2° above zero. One of the accompanying illustrations shows clearly one of the spans under construction. This illustration shows the manure in place. This was held in position by the simple method of using studding of 2 x 6 material to hold the form boards in place. Cleats and scraps of lumber were nailed to the outer edge of the studding

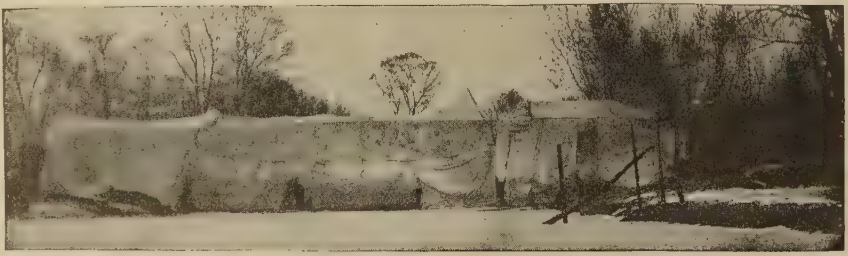


Fig. 1—Tent Enclosing Three-Span Reinforced Concrete Arch Permits Winter Construction

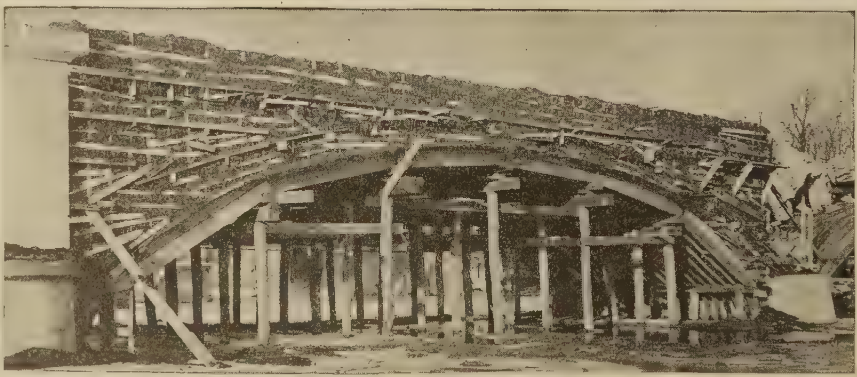


Fig. 2—Protecting Concrete in Cold Weather by Manure Held in Place by Cleats Nailed to Studding

sufficiently close together to hold the manure. The top of the arch ring was covered with straw to a depth of several feet.

Although the aggregates and the water for the concrete were heated before being mixed, the heat generated by the manure was sufficient actually to raise the temperature of the concrete during the first 48 to 72 hours after the concrete was placed. The contractor who built this bridge kept a careful record of temperatures.

From the foregoing it should be clear that even in cold climates concrete work on structures such as bridges, buildings, walls, dam, and in fact any other structure located on a limited site, may proceed without interruption regardless of cold weather.

The Portland Cement Association is publishing a very interesting booklet entitled "Winter-Built Concrete," which sets forth methods to be used and precautions to be taken when depositing concrete under cold weather conditions. That booklet may be obtained on request, free of charge.

Foundation Piers Enlarged in Building Operations

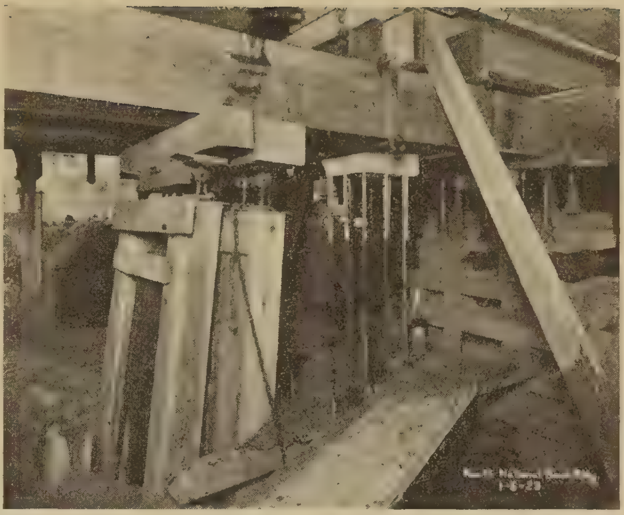
During the remodeling of the Fourth National Bank building in Wichita, Kan., it was necessary for the contractors to extend the eight main foundation piers of the building down an additional depth of 9 ft., to place a basement under the entire building and to construct a seventh story. In making the alterations, the building was shored up, the reinforced concrete piers cut off and new piers built larger and deeper.

The bank building was constructed of reinforced concrete on a sand foundation. When a 25-ft. addition was planned, it was decided to build another story on the older building and to place a basement under the entire building. In the basement is one of the largest safety deposit vaults in the state, constructed of reinforced concrete.

Fig. 2 shows the form filled with concrete for a new pier which is larger than the old one. As the piers rest on sand, much heavier bases were made for the new piers than were originally built.

On each of the eight piers lowered there was an estimated weight of 280,000 lbs. Four 10-in. x 20-in. wooden beams were placed around the piers and above these two 12-in. I-beams. Then 27 jacks were used between the shoring, set deep in the sand and the beams. A 4-ft. section at the bottom of each old pier was cut off and the forms set for the new piers. These were filled with concrete. After the concrete had set the shoring was removed and the construction of the basement started. At no time during the work did the building show any weakness. The work was under the supervision of C. A. Foreman, construction engineer, and Mike Hahner, general superintendent for the Geo. Siedhoff Construction Co.

The cost of lowering the piers and building the basement, including excavating, was approximately $22,000. The work on the basement was finished in 29 days. After the excavating, it took approximately four days to lower each of the main piers of the building. It was the first engineering feat of its kind to be tried in Wichita and was watched with interest.



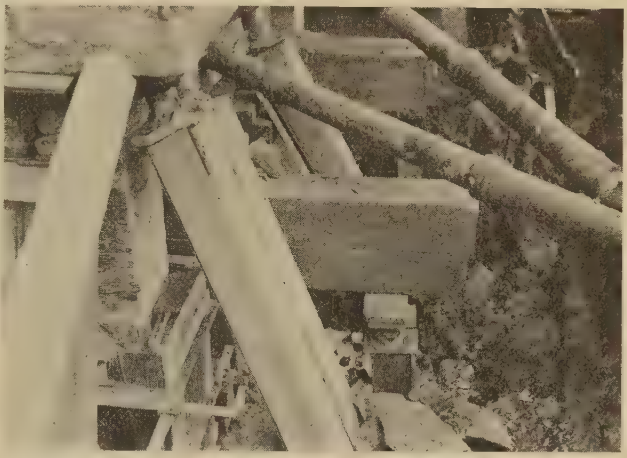


Fig. 1—Filling Forms for Base of New Pier with Concrete

White colored reinforcing rods on base of old pier show where it was cut off. New reinforcing was connected with the old rods to provide strength at the joint. The method of shoring the building is shown. This pier is under the elevator shaft.

Fig. 2—Method of Bracing and Shoring for Corner Pier. The Concrete Has Been Poured in the New Pier

Optical Strain Gage Invented at Bureau of Standards

A new optical strain gage for measuring the stretching of steel or other material under load has recently been perfected by the Bureau of Standards of the Department of Commerce. It will measure a change of length of 1/250,000 in. The part of the instrument which goes on the material is only 2 in. long and is very light, so that it could be used for testing thin sheets of metal or other light materials.

There is also an eyepiece which is used for reading the gage, and this consists of an instrument something like a telescope in appearance and containing lenses, a scale, and a lamp for illuminating the scale.

The gage itself has two knife edges which are set into the material under test. One is fixed in position, while the other can turn through a small angle to allow for the change in length of the material between the two edges. To the movable knife edge is attached a mirror which is one of a set of mirrors which reflect back to the eyepiece the image of an illuminated mark contained therein. This mark is projected on the scale in the eyepiece, and before the load is applied the gage is adjusted to make this mark coincide with the zero on the scale. Thereafter the scale reads directly the extension of the material to which the gage is fastened.

Absorption and Percolation

Water Repellent and Water Absorptive Waterproofings

A Letter from A. H. Rhett
Summitt, N. J.

The writer congratulates Concrete and through Concrete Alfred H. White for the publication of his paper on "Integral Waterproofing for Concrete" in the July issue as it furnishes some very interesting light on a subject which is not intrinsically obscure but is obscured by a hostile mental attitude on the part of many engineers that amounts almost to a fetich.

It would seem that the chief stumbling block in the way of a clearer understanding of the subject is illustrated in the title of this article,—"Integral Waterproofing for *Concrete!*" As a matter of fact no *concrete* was used in the tests. What was tested, as was also the case with the much discussed Bureau of Standards tests, was the effect produced on the absorptive property of portland cement *mortars* by the addition of various extraneous materials. The paper should have been entitled "Integral Waterproofing for Cement *Mortar.*" This is emphasized because it appears to be the crux of the whole difficulty. In testing any other property of concrete it would be considered quite obsolete to test mortar and then reason to concrete and yet when it comes to considering the question of waterproofing in such rare tests as are attempted, this process is considered entirely reasonable.

As a matter of fact, if in this question some incontrovertible facts bearing on the subject can be considered, it is not only not reasonable but on the contrary very unreasonable.

It is a fact, for instance, that water can enter mortar and concrete in two ways:

1st—Absorption,
2nd—Percolation.

It is also a fact that absorption can only occur when the pore is of minute or capillary size and that percolation can only occur when the pore is of appreciable or larger than capillary size.

It could not, further, be seriously questioned that the pores in a fairly dense cement mortar are principally of capillary size and that therefore water enters by absorption. This is very clearly shown in these tests. It can, too, be easily comprehended that the addition of a *water repellent* material to the mortar would decrease the absorption and the addition of a *water absorbent* material, such as lime or clay, would increase absorption, both of which facts are substantiated by the tests.

It can be said then, that as far as these tests have gone, they show that the absorption of water by cement *mortars* can be decreased by the addition of water repellent materials and increased by the addition of water absorbent materials.

That the entrance of water into *concrete* would be affected in the same way is most certainly not a necessary logical deduction.

If we consider concrete as mortar with stone added we have replaced about 70% at least of the absorptive element, the mortar, by a non-absorptive stone, and in this proportion decreased the absorptive factor of the concrete as compared with its equal volume of mortar.

On the other hand, in adding stone an entirely new element affecting the waterproofness has been added in the form of holes through which water will flow or percolate quite independently of any water that might be absorbed by the capillary or fine pores of the mortar.

Now the addition of a water repellent material to *concrete* will decrease absorption in the mortar element of the concrete, but it most certainly will not prevent the water from passing through the holes of larger size, and absorption is a minor factor.

Under the usual conditions where concrete is used, the little water that might be absorbed by the 30% of the absorptive constituent, is not a serious or troublesome matter. What is serious is the water that flows through the larger sized holes caused by the friction and segregation of the stones, the non-absorptive element.

As has been shown in these tests, the addition of a water absorptive material to *mortar* increases absorption, but it most certainly does not necessarily follow that the addition of a water absorptive material such as lime or clay to *concrete* will increase the flow of water through it.

In fact, there is a very considerable amount of evidence, based on practical experience, to refute it, to show that exactly the reverse is true and that concrete is densified by the addition of materials of this character. It is not very difficult either to find a rational explanation of this. The addition of a material of this character will certainly increase the absorption and diffusion of the *mixing* water throughout the mass and this cannot fail to increase plasticity or flowability, increase the hydration of the cement and decrease the necessity of superfluous mixing water to obtain plasticity. All three of these results would tend to improve the density and quality of the concrete.

It seems then that a reasonably substantiated conclusion might be drawn that the addition of a water repellent material to cement *mortar* will decrease absorption and keep the water out of it, while the addition of a water absorbent material to *concrete* will have a densifying effect, but the reverse is most certainly not true. The writer believes that the chief difficulty with this subject arises through a failure to make this distinction.

Water can be absorbed only by a minute pore; a large pore will not absorb.

Water will flow only through a hole of appreciable size, it cannot be forced through a capillary pore.

A water *repellent* material will grease a small hole and kill absorption. It cannot kill absorption of a large hole because there is no absorption to kill.

A water *absorptive* material will increase the absorptive power of small holes as shown in these tests, but will tend to close large holes in concrete through the physical action caused by a better absorption of the mixing water.

In cement mortar, small holes and *absorption* cause the trouble; therefore use a water repellent waterproofing.

In concrete, large holes and *percolation* or flow cause the trouble; therefore use a water absorbent material to close the pores. This is a rather lengthy explanation. I should also like to add, as the subject seems to be viewed with so much suspicion, that I have absolutely no commercial interest in it of any sort.

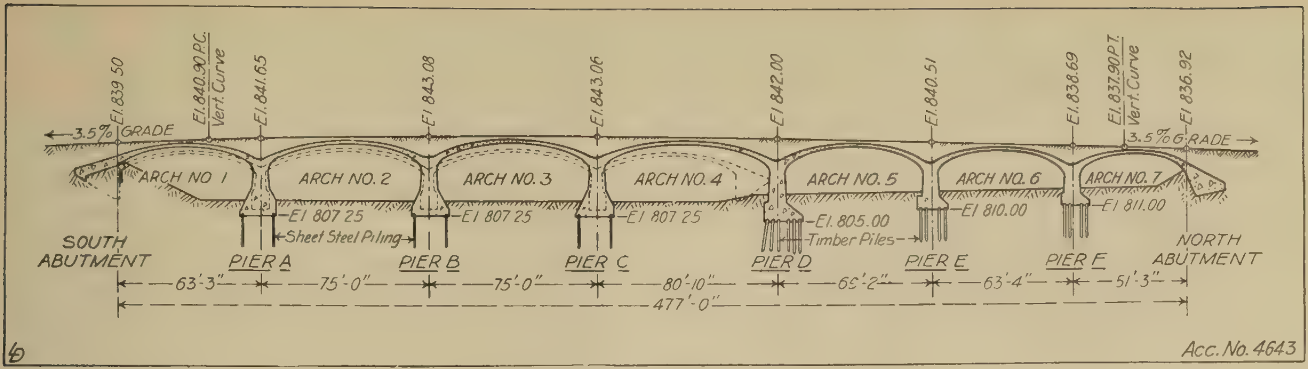


Fig. 1—Elevation of the Reconstructed Adams Street Bridge, Troy, Ohio

The position of the old arches and the outline of the piers before they were enlarged is shown by the dotted lines. The reconstructed bridge is shown by the solid lines. The enlargement of the old piers and the protective sheet piling around them should be especially noted.

New Concrete Bridge Built on Top of Old

The unusual feature of constructing a new concrete bridge on top of a similar structure already in place, using the old bridge to support the forms for the new, was present in the reconstruction of the Adams street bridge at Troy, Ohio. The work on this project is completed and is described in the *Miami Conservancy Bulletin* from which the following is abstracted.

The official plan of the district originally provided at Troy for a deep water channel for the Miami river following the old river closely and using the bridges as they then stood. Very large floods were to have been taken care of by making the levee on the north side of the river low enough so that a large flood would overtop the banks and flow over the low ground to the north

But as the time to build the works drew near, the Miami county people decided that a much more desirable plan for the future beautification of Troy would be to confine the flood channel within definite limits, lengthen the bridges to accommodate the enlarged river, and fill in and beautify the remainder of the overflow area. Leaving out the reconstruction of the two river bridges, the cost of the new plan did not greatly exceed the official plan. Miami county agreed to pay for lengthening the two bridges if the new plan was adopted. When the change was approved by the Conservancy Court the county entered into an agreement for the district to do the bridge reconstruction work for the county.

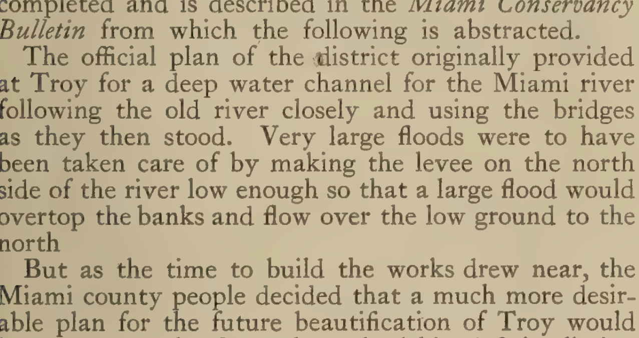


Fig. 2—Sketch Illustrating the Enlargement of the Bridge Piers

The Market street bridge had two steel trusses, and by adding another span sufficient waterway was secured. The Adams street bridge reconstruction was more of a problem. The old bridge was built in 1913, and consisted of four reinforced concrete arches. See Fig. 1. The outward appearance of the structure was good, but the pier footings were inadequate and some of the concrete was in bad condition. The footings were so narrow that they could not take care of the unbalanced forces from the new arches with a sufficient margin for safety. They were also set practically on top of the river bed, and were placed on a foundation supposed to be composed of 12-ft. piling, but some of the piling proved to be only 3 ft. long. The waterway under the bridge was wholly inadequate for the new plan.

The first idea would be to wreck such a bridge and build another. To remove a concrete bridge, especially the piers, is a big job and an expensive one. The district calculated that it would be cheaper to reinforce the old piers and use them to carry the new bridge, to use the old arches to carry the falsework for the new, and to add extra arches at one end, than to build an entirely new bridge. The obvious expedient of building a new bridge on a different site and digging a hole and bowling the old bridge into it, was barred because it was necessary to use the old site. The cost of securing the necessary property for the approaches to a new site was prohibitive.

Some very definite advantages were to be had by following this rather novel plan of utilizing the old bridge. The danger of floods washing out the timber falsework was done away with, as a clear waterway always remained under the bridge. Less timber was necessary in building the forms. No additional right-of-way was necessary. Considerable saving in the volume of concrete was secured. The disadvantages were principally in the trouble of reinforcing and underpinning the old piers, and in the adventuring into the unknown which this novel plan necessitated. Without precedent to go by, the greatest of care and thought was necessary to insure the success of each step in the work.

The design of the new bridge was simple. The irregular length of the spans of the old bridge governed the length of the three comparatively short spans

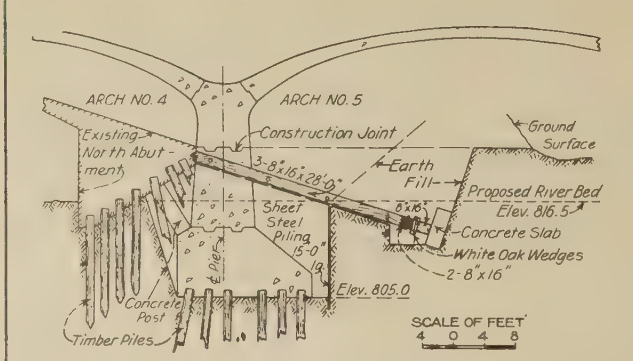


Fig. 4—Sketch Showing Construction of New Pier Behind the Old Abutment of the Adams Street Bridge

that were added at the north end, as the principle was adhered to of having the center span the longest, and having the spans decrease somewhat uniformly towards the ends. The deep water channel through Troy follows the old river channel and runs under the old bridge. The entire bridge is designed to carry a concentrated live load of one 20-ton truck, with 14 tons on the rear wheels and 6 tons on the front wheels. The sidewalks are designed to carry a live load of 100 lbs. per sq. ft. The materials will receive a maximum stress under total dead and live loads of 500 lbs. per sq. in. for the concrete, and 14,000 lbs. per sq. in. for the steel. These stresses are about one-quarter of stresses that would break the materials. A variation of 80° in temperature was considered a maximum. With the maximum temperature stress added to the maximum loading, the concrete would be stressed to 735 lbs. per sq. in. and the steel to 16,000 lbs. per sq. in., which are well within the limits of safety.

The deep water channel was under the old bridge, and therefore the building of the extension on the north end of the old bridge was carried on in the dry. Concrete sills were used to carry the posts for the falsework. The superstructure and forms commonly used for the piers, arches and abutment of concrete bridges, were used for these three arches. No unexpected contingencies came up and no unusual construction methods were employed.

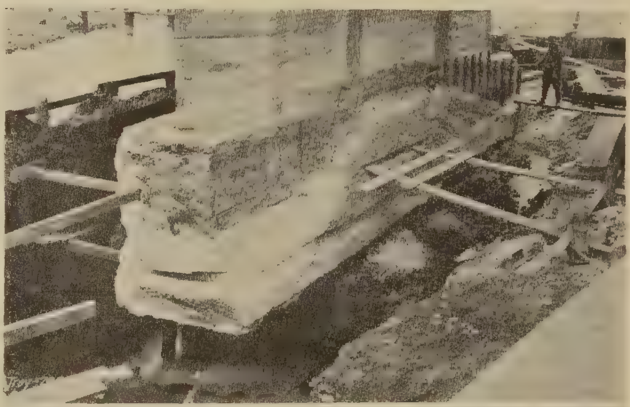
The spandrel walls, sidewalks, fill and paving were a considerable part of the dead load on the old bridge. They were removed before much work was done, in order that as little load as possible would be on the piers while they were being enlarged. It was necessary to remove these carefully and to unload all arches simultaneously and uniformly. Otherwise, unbalanced forces might have pushed over one of the piers. Most of the work was done by hand. Small shots of dynamite were used in breaking up the concrete wherever possible in order to lighten the hand work.

The first job in reconstructing the old bridge was to enlarge and deepen the footings. The rebuilt footings are almost twice as wide as the old ones, and extend about 3 ft. deeper into the river bed. A coffer dam of earth was thrown up around the pier, the water was pumped out, and the material around the footing excavated by hand. Taking one-third of the length of the old footing at one time, the excavation was carried 3 ft. below the bottom of the old footing, and then underneath. It was then that the condition of some of the old wooden piles was disclosed. Sheet steel piling 15 ft. long was driven one foot inside of the line of the new footing and projecting up one foot into the footing. Concrete was packed into the space underneath the old footing and around the old piles out past the line of the sheet piling. When the concrete was set, the next third was dug out and the operation repeated. Fig. 3 illustrates the procedure.

When the underpinning was all completed, holes were drilled through the old piers and the tie-rods placed through them. Then a jacket of concrete was placed entirely around the old piers, the network of steel in the jacket being held in place by the tie-rods.

The reconstruction work on the piers and the south abutment did not turn out to be as difficult as was anticipated, although high water stopped the work a number of times. The difficulty of driving sheet piling in the restricted space under the bridge was overcome by the use of a small, compact steam hammer.

The north abutment had to be replaced by a new pier immediately north of it. As the excavation for the new pier removed the bearing from behind the old abutment, some means of supplying a temporary support until the old bridge was taken down was necessary. Fig. 4 shows how this was accomplished. The heavy timbers, wedged against concrete footings, were placed in line with the direction of the force against the abutment and braced to prevent buckling. Then the excavating was done, and when the pier was poured the concrete was boxed around the timbers. The holes so left were filled in after the completion of the bridge permitted the removal of the brace for the old abutment.



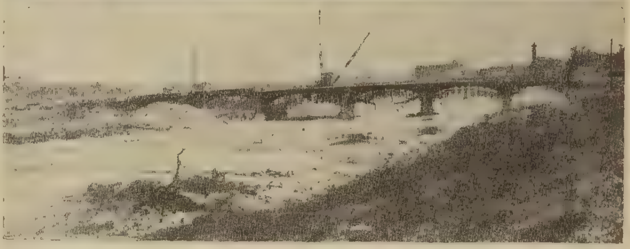


Fig. 3—A Pier of the Adams Street Bridge Ready for Underpinning

A coffer dam had been built, the gravel removed from around the pier, and the excavation made underneath the first third of the footing. The wooden piling underneath the old footing should be noted. The top of the line of protective sheet steel piling can be seen sticking out of the water in the bottom of the pit. Concrete was packed underneath the old footing and the entire pier was encased in a jacket of concrete.

Fig. 5—Adams Street Bridge, October 14, 1922

The old arches have been removed but some of the old reinforcing steel with chunks of concrete clinging to it can be seen under the 3rd arch from the right. The rods hanging down from the underneath side of the new arches were used to carry the scaffolding that supported the wrecking crews. If the necessity had arisen, the old arches would have been carried by these same rods during the wrecking process.

When all of the upper part of the old bridge save the arches was removed and the piers had been reconstructed, the forms for the new arches were built on top of of the old bridge. The only difference from the forms ordinarily used on such work was in the posts. Instead of the long bents resting on piles or sills in the river bed, the posts were short and rested on top of the old concrete arches, leaving an unobstructed waterway.

As the posts carrying the arch forms for the new spans on the north end rested on the ground, these arches could be poured in the usual way. But on the part of the new bridge that rested on the old, a different method was necessary. To have poured each new arch complete would have caused an unbalanced loading on the piers that would have been dangerous. So each arch was poured in three longitudinal sections, one section being poured on all of the arches, and then another, and finally the third. By proceeding in this manner, the unbalanced thrust on the piers did not exceed a safe figure.

When the new arch rings had set, the most ticklish part of the job, the removal of the old arches, remained to be done. Underneath the bridge a trench was dug, deep enough so that the old concrete falling into it would all be below the grade of the improved channel.

Then 1-in. holes were drilled through the old arches several feet apart longitudinally and 3 ft. apart laterally, and corresponding holes were cast into the new arches above. The holes were placed so that they would be ready for a certain contingency. Due to the same difficulty about having too large an unbalanced thrust on the piers, the old arches had to either all come down at once or else be removed uniformly. To have one old arch all removed with the others still standing might spell disaster. The practical difficulty of so managing affairs that all of the arches would let go and fall at the same moment was so great that this method was not seriously considered. So the piecemeal method was the one decided upon. The holes mentioned above were so arranged that bolts could be run through them, taken up a bit, and the lower arches suspended from the upper ones, in case that during the operations hereafter described the old arches showed any sign of failure. If this had happened, the suspended weight would have been very nearly equal on each side of each pier. The wrecking of the old arches was much easier than had been expected. Scaffolding was suspended from the upper arches by means of rods run through the holes mentioned above, and workmen using sledges, small charges of dynamite and chisels, began taking out little bites from all of the arches, working at about the same rate on all of them.

The network of reinforcing steel held the old concrete together very well and the steady nibbling reduced each arch to a very narrow rib without any necessity arising of suspending any of the old structure from the new. These last narrow ribs were cut and dropped without incident.

As soon as the success of the wrecking operations was assured, the new spandrel walls and sidewalks were started. The spandrel walls are built without brackets or batter. The sidewalks are cantilevered out without brackets. No unusual features were developed on either of these two items.

The construction plant was not elaborate. A derrick dug the gravel needed in addition to that already piled up on the site by the dragline. A portable gravel-washing and screening plant prepared the material for use. The aggregates were loaded into the Smith 1-yd. mixer by gravity, and the concrete was transported to the work in side-dump concrete cars that ran over a narrow-gauge track, up over the levee, and across the river on top of the forms. It was not necessary to hoist any of the concrete into position. A gasoline locomotive did the hauling.

The contractor who had the special work of reinforcing the old piers used a very simple layout. Part of the time he had his mixer on top of the old bridge and chuted the concrete down. The remainder of the time he brought in the concrete on a light trestle with a deck but a few feet above the water surface.

Reinforced Concrete Ribs for Roof of Seaplane Hangar

By Major Johnstone-Taylor
Shrewsbury, England

A good example of the application of reinforced concrete in the form of arched ribs is seen at the new Government Seaplane hangar at Copenhagen. These have a clear span of 140 ft. the general outline of the ribs being shown in Fig. 1, while sections giving the various depths and disposition of reinforcement are shown in Fig. 3.

There are six of these ribs placed at 21 ft. 10 in. C—C and connected by eight longitudinal beams of varying section, those at a—a′ serving to support two travelling cranes each having a capacity of three tons.

Design and Loads

The permissible stress allowed in the concrete is 640 lbs. per sq. in. compression and in the steel 17,000 lbs. per sq. in. tension. The total loading is made up as follows:

(1) Deadweight of roof which consists of 1¼-in. boards laid on 8-in. x 8-in. timbers. (2) Deadweight of arch. (3) Concrete purlins and bracings. (4) Snow and wind loads.

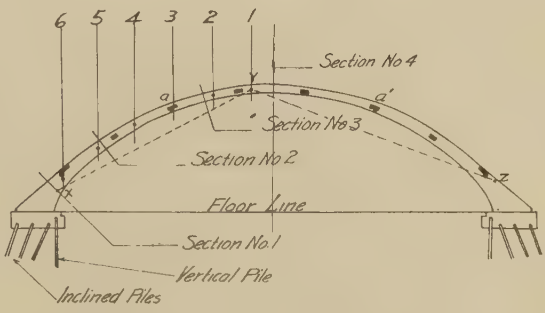


Fig. 1—Large Reinforced Concrete Arch Ribs for Hangar Roof

The arch is fixed in heavy abutments (see Fig. 2) and being restrained at the skewbacks becomes three times statically indeterminate. The line of thrust being set out as a funicular polygon to the acting external forces, the most advantageous direction of this line of thrust was found to pass through points x, y and z and the funicular polygon of the acting forces passing through these points being set out by drawing a vector diagram of the forces, a preliminary link polygon was constructed. By means of the vector diagram the normal thrust in any section was measured, the eccentricity being measured as the distance from the link polygon to the arch center line the bending moment on the section then being derived therefrom.

In a similar way the stresses introduced by the point loads at panels a—a′ were separately ascertained.

By this means the resulting bending moments for the panels 1 to 6 were found together with the corresponding thrusts, these being tabulated below.

Point	Maximum moment ft.-lbs.	Thrust lbs.
1	41,000	96,000
2	66,000	100,000
3	80,000	110,000
4	40,000	122,000
5	154,000	130,000
6	307,000	151,000

The requisite sectional areas to withstand these forces together with the amount of steel provided and the unit stresses in concrete and steel are set out below.

Point	Area width and depth	Steel % of sectional area	Stress	
			Concrete	Steel
1	1 ft.—11⅝ in. x 12 in.	1.05	548	7550T
2	2 ft.— 3⅝ in. x 12 in.	1.2	531	855C
3	2 ft.— 9½ in. x 12 in.	1.00	498	398T
4	3 ft.— 3⅜ in. x 12 in.	0.4	...	....
5	3 ft.—11¼ in. x 12 in.	0.35	590	2350T
6	4 ft.—11⅛ in. x 20 in.	0.15	625	5690T

The distribution of the steel in four of the sections is shown in Fig. 3, the position of these sections being shown in Fig. 1.

FOUNDATIONS

The foundation as seen in Fig. 1 consists of ferro concrete piles having a section of 10 in. x 10 in. There are 14 of these piles, that is, 7 each side to each rib, one of each set being a vertical pile and the others being sloped 1 to 2½ outwards from the arch.

They are reinforced with four ¾-in. corner bars tied with ⅛ in. twisted binding. The piles are carried into the abutment but not tied into it in respect of reinforcement.

The reaction of the arch is split up into two components, one vertical through the vertical pile and the other inclined through the sloping piles. The latter, however, does not pass through the centroid of the group of piles, these when considered as a section being subject to an eccentric force.

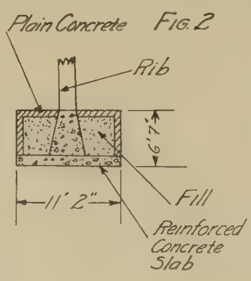
The actual abutments are in the form of slabs as shown in Fig.2. They measure 11 ft. 2 in. x 18 ft. and are 9⅞ in. thick. In order to give extra weight to the slabs the walls shown, 6 ft. 7 in. high, are built round it, the enclosed space being filled with rammed earth. The piles project into the abutment, the latter being heavily reinforced.

WIND LOADS

In the design a broadside wind load on gables was considered, the necessary rigidity being provided in the shape of the connecting wind braces as shown in Fig. 1, the whole system of arches and girders thus forming a wind girder carrying the wind load to the foundation.

CONSTRUCTION

The construction of these arches naturally demanded somewhat heavy scaffolding to support the shuttering; moreover, owing to the very exposed nature of the site, it had to be very heavily braced.



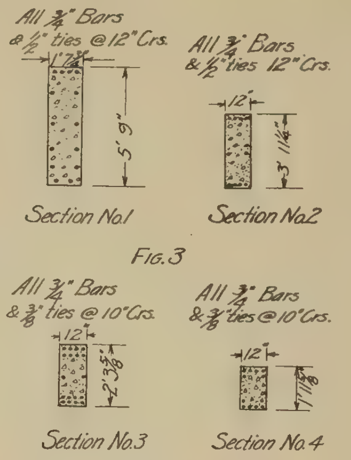

All ¾" Bars & ½" ties @ 12" Crs.
1'7¾"
5'9"
Section No. 1
All ¾" Bars & ½" ties 12" Crs.
12"
3'11¼"
Section No. 2
Fig. 3
All ¾" Bars & ⅜" ties @ 10" Crs.
12"
2'3⅝"
Section No. 3
All ¾" Bars & ⅜" ties @ 10" Crs.
12"
1'11⅝"
Section No. 4

FIG. 2—SECTION SHOWING ABUTMENT SLAB

FIG. 3—SECTIONAL DETAILS OF ARCH RIBS

The scaffolding in the main consisted of two ranges of 4-in. x 4-in. timber poles on each side of the arch and 3 ft. apart, the poles for the two ranges being braced horizontally in both directions every 6 ft. in height, while the scaffolding for the main arches was connected by the scaffolding for the longitudinal beams thus giving considerable strength in a direction lengthwise of the building.

The shuttering for the arches was supported by planks bolted to the poles on each side of the arch. On these planks two other sets of planks were arranged to the exact shape of the intrados of the arch and on these the bottom part of the shuttering was placed.

The side portions of the shuttering were strutted against the poles.

REINFORCEMENT AND CONCRETING

Round steel rods are used throughout, mostly of ¾ in. diameter and hooked at the ends. All steel was placed before any concreting was done. A 1:2:3 mixture was used, machine mixed. In order to ensure symmetrical loading of the scaffolding and to keep the load on the shuttering to a safe limit, the following procedure for concreting was adopted.

It will be seen from Fig. 1 that the longitudinal beams divide the arch into practically seven equal sections. Considering these as numbered 1, 2, 3, 4, 5, 6, 7, concreting was carried out in the order 1 and 7, 2 and 6, 3 and 5, and 4, only two sections—one on each side—being completed in one day. Thus, by allowing one section time to set before the others were commenced, the sideward pressure on the shuttering was reduced. All section joints were at right angles to the center line, while the casting of each beam was done at the same time as its corresponding section.

TESTS

On completion of the work a comprehensive series of deflection tests was carried out, measurements being taken at the center of each arch and at two points 35 ft. from the center. The maximum deflection was found at the middle, that at the side points being insignificant. Deflections at the center were found to continue for three or four days, due not to settling of the foundations, which would have evinced itself in deflection at the side points, but to elastic deformation of the arch. The total deflection at the center varied from ⅙ in. to ¾ in., quite a small amount in view of the size of the arch.

A New Heat Insulator —Balsam-Wool

By disintegrating waste wood and rearranging the fibres so as to obtain a maximum of dead air cells, there has been developed an insulating material which has a lower thermal conductivity than Balsa, the lightest natural wood.

This article describing the making, characteristics and uses of this product is from *Chemical and Metallurgical Engineering* and is published here as a further consideration of house insulation following the article written for CONCRETE, September issue, by Mr. H. J. Burt.

By HOWARD F. WEISS

WOOD PRODUCTS ENGINEER, C. F. BURGESS LABORATORIES, MADISON, WIS.

One of the most inherently valuable properties of wood is its resistance to the passage of heat. It is for this reason that wood appeals to us for a variety of uses, such as furniture, tool handles, rims for automobile steering wheels, gun stocks, floors, etc. Substitutes find this property in wood a difficult one to overcome in the ever-present battle of replacements.

The reason wood is so resistant to the passage of heat is because of its structure. Unlike most construction materials, it is a built up product made of a great mass of hollow fibers cemented together. These lock up within the wood an enormous number of air cells, so small that the air in them cannot readily circulate. The air is, therefore, commonly referred to as being "dead," and dead air is one of the most effective heat insulators known.

A fact not generally known is that the wood substance itself—that is, the material out of which the wood cells are made—is comparatively heavy and weighs about 96 lb. per cu. ft. Water weighs about 62.5 lb. per cu. ft. Hence if solid wood substance is placed in water it will immediately sink. What keeps wood afloat, therefore, is the millions of dead air cells and cavities scattered throughout it. They buoy it up. It is well known that the different woods vary in weight, some being heavy and some light. This is because the heavy woods are largely solid wood substance and have comparatively few dead air cells, while the lighter woods have less wood substance and a large number of dead air cells. Oak and hickory are good examples of common heavy woods, while cedar and white pine are good examples of woods light in weight. The former weigh 40 or more lbs. per cu. ft., while the latter weigh only about half as much.

If our belief that a material having a large number of dead air cells is a good heat insulator is correct, then we would expect to find that the woods that are lighter in weight are better heat insulators than the heavy woods. This is exactly the case. For example, the United States Bureau of Standards in studying the heat conductivity of various materials has found that balsa wood, which is one of the lightest woods known, shows remarkable resistance to the passage of heat. The results of the bureau's tests are shown in Table I.

TABLE I—THERMAL CONDUCTIVITY OF WOOD

Name of Wood	Weight, Lb. per Cu. Ft.	Conductivity, B.t.u. in 24 Hr., per Sq. Ft., 1 in. Thick, per Deg. F.
Balsa wood	7.5	8.3
White pine	30	19
Hard maple	45	27

Balsa wood weighing less than 8 lb. per cu. ft. shows a heat loss of only 8.3 B.t.u. under the bureau's test, as against 27 B.t.u. for maple, which weighs 45 lb. per cu. ft. In other words, a board of balsa wood 1 in. thick is as resistant to the passage of heat as a maple board more than 3¼ in. thick.

As this problem of preventing the passage of heat is of immense importance in our daily life, not only in the construction of ice boxes, refrigerator cars, pipes, etc., but in the building of comfortable homes, the C. F. Burgess Laboratories undertook a series of experiments to see if the fibrous structure of wood could be rearranged so as to build up a material that would be lighter than any wood heretofore known and that would have a greater number of dead air cells. It seemed logical that if this could be done a very efficient heat-insulating product would be the result.

After months of experimenting, the new product was finally developed. The material, to which the name Balsam-Wool has been given, weighs only 3 lb. per cu. ft., less than one-half as much as balsa wood and about one-fourth as much as cork. When tested for thermal conductivity, it showed the remarkably low thermal conductivity of 6.1 B.t.u., as against 8.3 for balsa wood and 7.4 for pure cork, and these latter are the most efficient heat insulators made from wood heretofore known.

TABLE II—COMPARATIVE THERMAL CONDUCTIVITIES OF VARIOUS BUILDING MATERIALS

Name of Material	Thickness Required to Equal ½ in. of Balsam-Wool, In.	Cost of Material per 1,000 Sq. Ft. Wall Surface for Thicknesses Required to Equal Insulation Value of ½ in. Balsam-Wool
Balsam-Wool	0.50	$50.00
Sheathing lumber	1.58	99.00
Common brick	8.00	350.00
Sheathing paper (solid)	1.59	570.00
Lime plaster	17.00	1,165.00
Stucco	17.00	1,165.00

The thermal conductivity of various building material compared with Balsam-Wool is shown in Table II. The prices are material costs only as of June, 1923, at Madison, Wis. If labor were included, the margins between Balsam-Wool and the other materials would be still greater.

Several patents were granted on both the product and process. The work was financed and the product is now being manufactured by the Wood Conversion Co., Cloquet, Minn., at the rate of 50,000 ft. per day under the trade name of Balsam-Wool. About 2,000,000 sq. ft. was used in the construction of homes throughout Minnesota last fall and the returns now coming in from home owners show that the product is doing all that the laboratory tests indicate it would do—namely, saving these home owners from 30 to 40% in coal and contributing to the maintenance of comfortable, healthy, quiet homes.

Balsam-Wool can be made from those products of the sawmill too small in size to have commercial value. For its manufacture the slabs, edgings, trimmings, etc., left after the logs have been cut into lumber, box, shooks and lath, are passed to a hog instead of to the burner and are cut to hog feed. This hog feed is further reduced in size by passing through a shredder so that the slivers are not over ½ in. in length. The shredded wood is then boiled in an alkaline solution to loosen the cementing material which binds the wood fibers together. The next step is to comb the fibers one from another, this being done in what is known as a beating engine. Thus the wood is reduced to individual fibers.

Having thus separated the individual fibers one from another, the next step is to build them up again, but in a different arrangement from that which nature gave them in the living tree. Before doing this, however, the fibers are passed through a fireproofing solution which renders the finished product fireproof. The fireproofed fibers are pressed until they hold only about 40% moisture, after which they are passed through a drier in which their moisture content is reduced to 10%.

In this condition the fibers are blown into a large dry fiber bin. From this dry fiber bin the fibers are fed into a shredding engine and fan, which further comb out any fibers that may be in lumps or bundles. The fan then blows them to fiber hoods. These hoods are so designed that the stream of fibers is split into fan-shaped curtains of fiber which blow against a traveling wire screen 6 ft. wide, moving at a lineal speed of 12 ft. per minute. As the fibers are falling from the fiber hoods to the traveling screen, they pass through an atmosphere of cement that cements the fibers. Thus, upon striking the screen the fibers are sticky and each fiber is cemented to its neighbor. However, the arrangement of the fibers is such that they project in all three dimensions so that the finished product has no grain as has the natural wood. It is because of this formation that the product is so extremely light in weight—only 3 lb. per cu. ft.

The endless wire screen carries the layer of wet sticky fibers with their water-resistant cement through a drier, where the water in the cement is evaporated and the fibrous product comes out at the other end of the drier in a continous sheet 6 ft. wide and ¾ in. thick. This sheet of fibers is continously clipped from the screen and passed between two sheets of tough kraft paper, coated on the inside with a thin layer of hot water-resisting asphalt. The "wool" thus coated on two sides with its layer of weather-resisting kraft liners passes through a slitting and cutting-off machine, which cuts it into lengths of 90 ft. and widths of 16½ and 32 in. After this, the product is wound into rolls and wrapped with heavy layers of waterproofed paper. In this form it is ready for the market.

There are now on the market several varieties of heat insulators made from hair, seaweed, flax straw, waste sugar cane, pulp screenings, etc., but none of them, with the possible exception of hair, is as heat resistant as this new product made from the fibers of coniferous trees.

The public is rapidly learning that better construction in building homes is the cheapest and best policy, particularly in frame construction. Homes built of improperly seasoned lumber that shrinks and warps, causing plaster to crack, paint to peel, joints to open, etc., are expensive to maintain. Likewise, the public is demanding more and more comfort in every way. Cold, clammy, drafty, noisy houses are objectionable not only because of their uncomfortableness but also because of the expense of heating them. With good insulation, the home owner can have not only added health and comfort, but decided economy as well. It is estimated that good insulation will save from 25 to 40% on the amount of fuel required to heat the home, the variation depending upon window area. Furthermore, a smaller heating plant will suffice and this saving (20 to 25%) should about pay for the cost of insulation.

Uninsulated houses are becoming too expensive for the mass of the people to live in and more economical homes will be in demand. The field ahead for house insulation is therefore tremendous. Numerous industrial uses for this fire-resistant efficient insulating material also suggest themselves. These facts are so firmly established that the company is building an addition which will double the present capacity of the plant.

CONCRETE particularly welcomes discussion of heat conservation in concrete dwelling house construction.

Winter Operation of Products Plants—Extra Profits

By Charles Luther Bourne

The customary inactivity of concrete products plants during cold weather is usually followed by feverish activity upon the opening of the construction season. An idle plant when labor is plentiful becomes overloaded with orders for its output when ordinarily labor is in great demand. The products manufacturer, in general, wastes the opportunity to prepare during dull periods for the business which he knows is coming.

The concrete products manufacturer is both a producer and a dealer. Many of his problems are the same as those found in making and selling any commodity for which the demand is seasonal. Suppose the hat manufacturer never made a straw hat until he had an order for one from a storekeeper who never ordered it until a customer had come into his store for one. This seems ridiculous but is comparable to the manner in which many products manufacturers conduct their business.

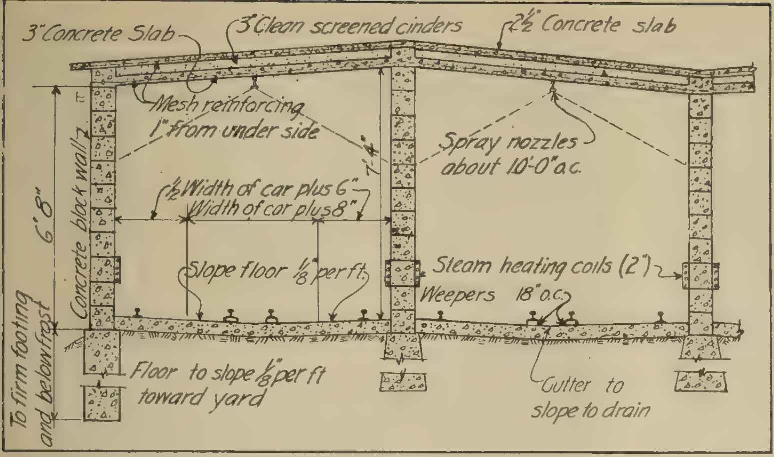
One objection raised against cold weather operation of products plants is that considerable capital is necessary to build up a stock pile which is inactive until the products are sold. Does not a closed down plant itself represent capital which is not working? Continuous capacity production not only reduces the cost of each concrete unit but results in a volume of business which means increased profits.

The only circumstances under which continuous operation of products plants does not result in additional profits are those of a slack market which will not consume the manufactured product. In the past few years, the use of concrete products has increased much faster than new plants have been established.. The plant which cannot sell the output obtained from continuous operation is not well situated in respect to a market.

Until very recently, most concrete products plants closed their doors during cold weather. Several years ago, a few manufacturers worked during the winter with a reduced crew. When Spring came, the small stock which had accumulated soon disappeared. These manufacturers then inaugurated a full winter program with the result that they continued to do so. Other plants followed their example and have been equally successful. Each year the number of continuously operated plants increases but they as yet represent a very small proportion of the total number engaged in the industry.

Each manufacturer can estimate the results which may be expected through cold weather operation of his own plant. This involves a study of the initial cost of additional equipment required and of the effect of increased volume of business upon profits. The figures used in the following discussion of these considerations are assumed for the purpose of illustration only. The manufacturer who uses the tables shown for making estimates should substitute actual local costs in lieu of the figures given.

Cold weather operation is not practical without facilities for at least 48 hours curing of products. Concrete must be well hardened before it is exposed to low temperatures. Moisture is necessary for hardening concrete and a premature drying out always results in weak



Spray and Heat Give Better Curing Conditions Than Moist Steam—Details of Curing Rooms So Equipped Are Shown—They Make Possible a Better Revenue on the Whole Products Plant Investment

concrete. Heat hastens the hardening of concrete. Without special rooms in which both heat and moisture are present, concrete products would require considerable time to harden enough to be piled outside in freezing weather and very large heated rooms would be required to store hardening products. Heat can be supplied through steam and moisture by the release of saturated steam or by introducing water pipe fitted with fog nozzles or compressed air water vapor atomizers.

For the purpose of estimating, a plant producing 1200 concrete block daily will be assumed. Curing rooms, then, will be designed for two days output or 2400 block. The type of curing room selected is shown in Fig. 1. Four chambers, each 40 ft. long, will be required. An estimate of cost is as follows:

ESTIMATE OF COST OF STEAM CURING EQUIPMENT

For Concrete Block Plant—1200 daily capacity (Curing Rooms—2400 block capacity).
(For plant in operation—deduct equipment on hand).

Curing Rooms—4 Curing Rooms—40 ft. long each—2 tracks in each room			
Footings—200 ft.—1' x 3' = 22.5 cu. yds. concrete 1:2½:5 mix @ $12.00 cu. yd. in place			$ 270.00
Floor—5" concrete—1:2:4 mix @ 15¢ per sq. ft.			225.00
Concrete Block Walls—120'-10 courses high need 1200 block			
" " " 80'-11 courses high need 880 block			
Block required 2080			
2080 block @ 14¢		$291.20	
Labor— Mason—65 hrs. @ $1.25		81.25	
Helper—65 hrs. @ 75¢		48.75	
		421.20	
Roof—4" concrete—1:2:4 mix—Reinforced by ½" bars 8" c. to c.			
1500 sq. ft. forms @ 14¢ per sq. ft.		$210.00	
4"—1:2:4 concrete in place @ 18¢ per sq. ft.		270.00	
Rein.—1920 lin. ft. of ½" bars—1267 lbs. @ 6¢ per lb. in place		76.00	
			556.00
Doors—4—7'-6" x 7'-0"—Special Top—Made on job @ $30.00			120.00
Heating—15 H. P. Boiler installed		$1000.00	
Radiation—1280'—2" pipe	$450.00		
40'—3" pipe	27.00		
180'—5" pipe	235.00		
Hangers	80.00		
5 valves	20.00		
	812.00		
Labor	563.00		
		1375.00	
			2375.00
Lighting—200' wire—12 sockets—12-50 Watt lamps, 40 insulating knobs—Labor			37.80
Water pipe—with fog nozzles—in place			125.00
			4130.00
Accessories			
Track and Cars			
600 lin. ft. of 24" gauge track (in yard)			
400 lin. ft. of 24" gauge track (in rooms)			
70 lin. ft. of 24" gauge track (in main plant)			
1070 lin. ft. track @ 20¢ with spikes plates, etc		$ 268.00	
2 Transfer Cars @ $50.00		100.00	
34 cars (72 block capacity each) @ $40.00		1360.00	
Track Supports (600 lin. ft. in yard)		75.00	
Labor laying track		150.00	
			$1953.00
1200 pallets @ 30¢			360.00
(Note—1200 extra pallets are required for winter operation because of 48 hour curing)			
			$2313.00
Summary—Curing Rooms		$4130.00	
Accessories		2313.00	
Total Cost		$6443.00	

The estimate of cost of steam curing equipment shows that approximately $6500 is required to provide for curing 2400 block. The boiler has capacity for keeping the curing rooms at about 100° F. when the outside temperature is zero and the rooms are constructed as shown. The size boiler shown will also heat the main factory, if not too large, enough so that men can work comfortably. An automatic regulator should be placed upon the boiler.

Many plants now habitually steam cure during the warm weather and close during the winter. Such plants have already curing space for one day's operation and their present facilities can be used with additions to provide for a full two day's run.

Referring to the accompanying table of costs of manufacturing, it will be seen that the actual additional cost of steam curing in cold weather is more than offset by overhead expenses which continue throughout the year. The reason for this is found in the increased production. A study of the table will show the actual cost of steam curing. An additional man is needed for tending the boiler in the night. Experience shows that 1 lb. of a good grade of coal will cure an 8 x 8 x 16 block. Assuming $10.00 a ton for coal, fuel will cost ½c per block. Interest upon a larger plant investment, a larger stock in the yard and more accounts outstanding must be accounted for. Depreciation of additional buildings and equipment is noted. In spite of all these expenses, there is no additional cost per block, as curing costs are balanced by larger output.

With the facts already presented the effect of continuous operation of products plants upon profits can be shown. Business is conducted for profit and business success is measured in terms of the amount of profit realized in relation to the capital required.

Assume a selling price of 19c per block. Our 1200 block plant, operating 8 months (200 working days), producing 240,000 block at $136.93 per thousand, will show a net yearly profit of $12,737. Operated 12 months (300 working days) and producing 360,000 block at $135.05, it will make a net yearly profit of $19,782. The actual gain in profits is $7045.

This additional $7045 profit can be made by additional investment of the owner or upon borrowed capital; for 7% interest upon the additional capital required is included in the manufacturing cost. In the first case, the owner receives this interest, in the latter case, the banker or other lender receives it.

In a short discussion of this nature, it is necessary to analyze one condition which is typical of general conditions. The two tabulations, however, have been compiled in such a form that they can be used for a variety of conditions. It is only necessary to substitute figures applying to any specific case. By this means, any concrete products manufacturer can estimate the value of additional production in his own business.

There are many advantages in winter operation which are not directly shown in the strictly financial summary which has been presented. A good stock on hand enables the manufacturer to give good service to his regular patrons. An unexpected large order can be handled without crippling the regular trade.

Continuous employment is very attractive to the best class of workmen. Through its means, a body of hard working, loyal and contented employes can be built up and retained. Efficiency and a low turnover of labor pay large dividends although it would be difficult to estimate their value definitely in dollars and cents.

Materials are sometimes cheaper in winter. Advantage can then be taken of any favorable market conditions.

The construction period usually begins with a rush in the spring. Ability to meet spring demands with well seasoned stock and by immediate delivery upon orders is a distinct business asset.

The products manufacturer who has not formerly operated his plant in winter and decides to do so, must act *now*. He can arrange his plant for cold weather work in a short time if he *gets busy*. 1924 promises to be as active in building construction as this year. Quick decisive action may increase the profits of many concrete products plants 50% next year.

COST OF MANUFACTURE OF CONCRETE BLOCK

Comparison between costs with seasonal operation of plant and no steam curing and with continuous operation and steam curing.

Daily production 1200 block	8 mo. operation no steam curing 200 working days 240,000 block		12 mo. operation steam curing (4 mo.) 300 working days 360,000 block	
Direct Manufacturing Costs	Daily	Per 1000 Block	Daily	Per 1000 Block
Cement—(1200 blk.) 69 sacks cement @ 65¢	$44.85		$44.85	
Aggregate 18 cu. yds. @ $2.00	36.00		36.00	
Labor—5 men	21.00		21.00	
Labor (Curing) 1 man			5.00	
Facing Material (if used)				
	$101.85	$84.88	$106.85	$89.04
Indirect Manufacturing Costs	Yearly		Yearly	
Repairs	$600.00		$900.00	
Fuel			600.00	
Power and Light	500.00		750.00	
Liability Insurance	170.00		255.00	
Small tools, oil, etc.	120.00		180.00	
	$1390.00	$5.79	$2685.00	$7.46
Overhead and Selling Costs				
Manager @ $250 per mo. (12 mo.)	$3000.00		$3000.00	
Bookkeeper @ $125 per mo.	1000.00		1500.00	
Interest Plant Investment and Operating Capital—7%	1820.00		2275.00	
Interest Inventory	100.00 (7% $4.000)		500 00 (7% $6 000)	
Interest Accounts Receivable	280.00		420.00	
Office Supplies and Telephone	360.00		400.00	
Land Rental	300.00		300.00	
Fire Insurance	100.00		100.00	
Taxes ($2.25 per $100)	352.00		498.00	
Automobile @ $60 per mo.	480.00		720.00	
Advertising	1000.00		1000.00	
Depreciation (Bldg. 5%, Equip. 25%) and Obsolescense	2310.00		3160.00	
	$11,102.00	$46.25	$13,873.00	$38.55
		$136.93		$135.05

NOTES

Overhead and Selling Costs should be kept separate in accounting systems.
Investment in Building without Steam Curing $8000, with steam curing $12,000;
Investment in Equipment without steam curing $7650, with steam curing $10,150;
Investment in Plant and Operating Capital without steam curing $26,000, with steam curing $52,500.

How World's Largest Swimming Tank Was Built of Concrete

The largest swimming tank in the world is now nearing completion in San Francisco, as an integral part of the great park and playground program planned for the city. It is at the intersection of the Great Highway and Sloat Blvd., near the ocean front.

The swimming tank is built of reinforced concrete, 1000 ft. long and 100 ft. wide except for a center portion which measures 150 ft. across, and will accommodate 10,000 persons. It is being built at an estimated cost of $80,000.

The entire undertaking is being carried on under the direction of the Park Commission, the pool being constructed according to plans of Earl Clements, engineer for the commission.

The tank will be completely standarized, so that official swimming meets, such as those of the Olympic games, can be held in it. In order to meet the requirements for these meets the tank will of necessity be correct within very close limits.

This is to be a salt water swimming tank, which has necessitated many special features of construction. The tank is divided into integral sections for the reason that there is no direct bearing between its different components. The walls are divided into 60-ft. sections joined by wedge-shaped expansion joints, forming a key which interlocks the two wall sections. Each seam is composed of five strips of Carey Elistite and two 4½-in. 13-gauge copper sheets put in to eliminate any possible chance of salt water from the pool getting into or through the concrete, also to prevent ground water from entering into the concrete at the joints.

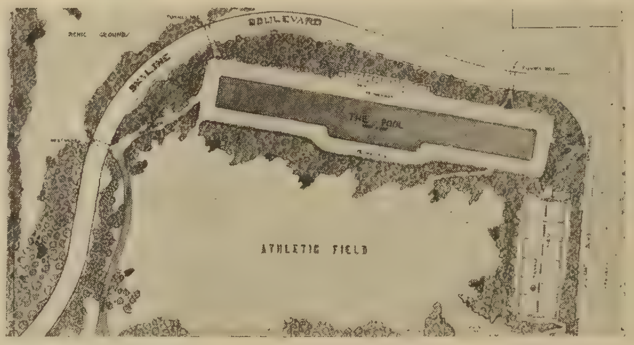
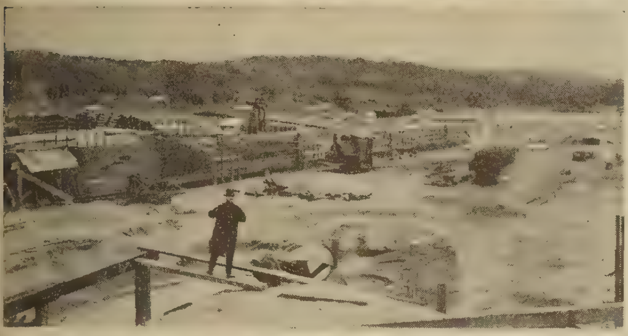
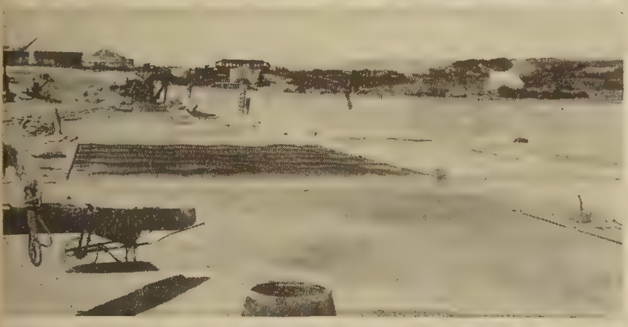


FIG. 1—LANDSCAPE PLAN OF SAN FRANCISCO'S MUNICIPAL SWIMMING POOL

The bottom of the tank is interlaced with expansion seams running longitudinally and transversely, the longitudinal seams being 42 ft. apart. These expansion seams rest on 5-in. reinforced concrete footings 3 ft. wide. This footing was given sidewalk finish and painted with coal-tar to prevent possible bond between the floor slab and footing, thereby making expansion possible without disruption to either floor slab or footing. The expansion joints are calked with 1-in. spun oakum and the remainder of the seam poured with Hill plastic asphaltic cement. The concrete mixture





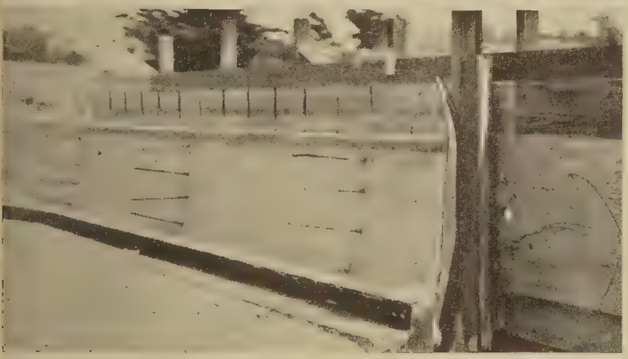


Fig. 2—General View of Pool Showing Shallow End in Foreground

Fig. 3—Methods of Pouring Concrete for Walls. The Water Seepage in Foreground Will be Pumped Out and Used for Irrigation Purposes

Fig. 4—Four Stages of Concreting. Reinforcing Steel in Distance. In Foreground is Concrete Before the ½-in. Finish is Applied. At Right the Finish Has Been Applied—At Left is One of Concrete Footings Supporting Floor Slab

Fig. 5—In Foreground is One of the Expansion Joints with Copper Sheets Extending above the Wooden Forms. At Bottom of Picture is Footing Painted with Coal Tar on Which Floor Slab Will Rest. The Steel Bars Are for Concrete Steps Which Will Extend into Pool

was 1:2:4. To this mixture was added hydrated lime (equal to 5% of the weight of the cement) as an integral waterproofing of the mass concrete.

The floor slab is 5 in. thick, which is 4½in. structurally with ½-in. cement finish on the inside. The reinforcement used in the floor slab consisted of No. 4 electric welded fabric placed 3 in. from the top of the finished floor. The cement finish was made by using a 1:2 mix portland cement mortar, to which was added 5 lbs. of Truscon waterproofing compound for each sack of cement. The entire inner surface was finished with this mixture to overcome the chemical action of the salt water on the concrete and to give a smooth and even finish to the interior of the tank thereby preventing possible growth of alge.

At every 100-ft. point precast reinforced concrete steps or ladders were placed when the walls were being poured.

The pool varies in depth fron a maximum of 3 ft. at the shallow end to a maximum of 9 ft. at the deepest end, the varying distances and depths being marked on the concrete wall. At one end there is a diving pit 14 ft. deep.

A layer of rock screenings 6 in. thick was rolled to form a sub-base for the floor. Eight-inch drain tiles were placed below the bottom of the tank to take care of the hydrostatic pressure. These tiles drain into a fresh water well, from which the water is pumped by electrically driven pumps and used for irrigating the Municipal Golf Links in the vicinity of the swimming pool. The hydrostatic pressure is considerable as the level of the ground water is the same as that of the salt water in the pool. If provision had not been made for pumping this fresh water from under the bottom of the pool the concrete bottom would tend to bulge upward when the pool was empty.

Ornamental concrete pump houses are built over the six independent pumps. The salt water is pumped into the pool by means of a 12-in. centrifugal pump direct connected to a 75 H. P. electric motor, pumping the water through a pipe line laid 200 ft. beyond the zero tide line. This line is supported on a concrete pier. In draining the tank the water is permitted to run out through this same pipe line. However, it will be necessary to pump 5 ft. of water from the 14-ft. diving pit because the bottom is below sea level.

A 50-ft. concrete promenade surrounds the pool, where concrete seats will be provided for spectators. There will also be a concrete building 600 ft. long which will contain 750 individual dressing rooms A small concrete wading pool will also be provided for the children.

A Chicago gasoline concrete mixer was used in constructing the walls. The mixer was run on a special wooden track which paralleled the walls, the concrete being delivered directly into the forms and no wheeling necessary. A steam driven concrete mixer was used in placing the floor and all concrete from this mixer was run directly into place, without wheeling.

Selling Burial Vaults

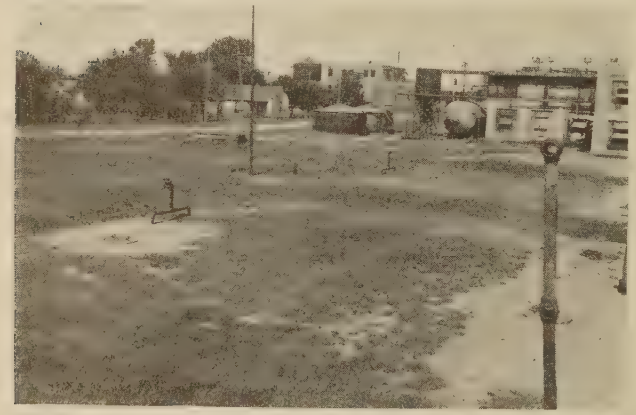
A concrete burial vault manufacturer in a small town in Missouri was trying to get his business started not only in his own town but in other towns in the surrounding country within a radius of about 20 miles. In one place of 200, where there were two undertakers, he met with decided undertaker opposition. Neither one would handle his vaults or attempt to sell them. He prepared a special circular letter explaining the merits of Norwalk vaults, put these letters into envelopes but left them unaddressed. He took a bundle of these letters to the young woman who operated the local telephone exchange and made her an agent for Norwalk vaults, giving her $2.50 for every vault sold. The scheme was this. The operator would be the first, perhaps, outside the family, to learn of a death. She was then to address and send by special messenger, one of the circular letters to the head of the family in which the death had occurred. This method resulted in the sale of many vaults and a good business has been built up from this start.

Concrete Tanks for Inflammable Liquids

The use of reinforced concrete storage tanks for liquids heavier than 35° Baumé is approved in the report of the Committee on Inflammable Liquids, appointed by the National Fire Protection Association. This was adopted at the annual meeting of the Association, in May and published in the 1923 *Proceedings* of the N. F. P. A. In this respect it is in agreement with the American Concrete Institute's Tentative Recommended Practice and Standard Specifications for Concrete Fuel Oil Tanks. While this means that concrete is not recommended for gasoline storage, the fact remains that many reinforced concrete gasoline storage tanks are in successful use. In Muskogee., Okla., alone the Oklahoma Producing and Refining Co. has two batteries of reinforced concrete gasoline storage tanks totaling 16 in number, with three or four single tanks in other parts of the plant. The tanks are outside and underground and are giving the best of service. One of the accompanying illustrations shows "a view" of three of those tanks, made from a sort of "cat-and-canary" photograph, since only the vent pipes protrude above the ground. The area occupied by the tanks is available for storage and other yard use.

The N. F. P. A. Report divides containers for the storage of inflammable liquids into five classes, as follows:

Class A. Individual Underground Storage Systems Without Inside Discharge
Class B. Inside Discharge Systems
Class C. Portable Tanks
Class D. Stationary Tanks in Buildings
Class E. General Storage



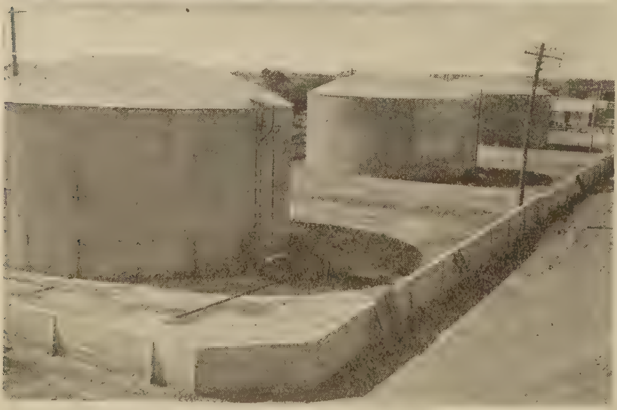


Fig. 1—Gasoline Storage Tanks of Concrete Underground
Fig. 2—Reinforced Concrete Dykes for Steel Tanks

Inflammable liquids are classified according to their flash points, as follows:

Class I. Liquids with flash point below 25° F. Closed Cup Tester
Class II. Liquids with flash point above that of Class I and below 70° F. Closed Cup Tester
Class III. Liquids with flash point above that of Class II and below 200° F. Closed Cup Tester

Under the heading "Material and Construction" the N. F. P. A. Report specifies the following for the various classes of containers indicated.

Class A. Tanks shall be constructed of galvanized steel, open hearth steel or wrought iron of a minimum gauge (U. S. Standard) depending upon the capacity as given in Tables 1 and 2. For liquids heavier than 35° Baumé, tanks may be of concrete.

Class B. Same as Class A.

Class C. Tank shall be made of iron or steel plate not less than $\frac{3}{16}$ in. in thickness with joints either riveted and caulked, welded, brazed or made tight by some equivalent method. Where necessary, tanks shall be substantially braced.

Class D. Rectangular tanks shall be made of sheet iron or steel not less than No. 14 U. S. Standard gauge in thickness. Cylindrical tanks not exceeding 120 gals. capacity shall be made of sheet iron or steel not less than No. 20 U. S. Standard gauge. Material lighter than No. 16 U. S. gauge shall be galvanized.

Class E. Tanks, including top, shall be constructed of open hearth steel or wrought iron of a thickness depending upon the capacity and to be figured in accordance with the following table or formulas. No open tank shall be used. For liquids of 35° Baumé, or heavier, tanks may be constructed of concrete in accordance with the requirements of the National Fire Protection Association.

The N. F. P. A. Report requires also that all tanks built above the ground be surrounded with continuous dykes not less that four feet high and having a capacity at least equal to the tank capacity enclosed. Some city ordinances, among them the Chicago Muncipal Code, require the capacity of such enclosures to be one and one-half times the tank capacity, though it is not at all clear why the capacity of the dyke should be greater than that of the tank or tanks which it encloses. Neither is it clear why the N. F. P. A. report should establish a minimum height of four feet for the dyke. In a case where a height of three feet provides the necessary capacity, why should the dyke wall be made four feet high?

Another illustration shows a series of three reinforced concrete dyke enclosures around steel tanks in the Muskogee plant of the Oklahoma Producing and Refining Co. As this view clearly shows, the space within the dyke walls is not available for yard storage or other yard use. This emphasizes the advantage of underground tanks of concrete, which are preferable not only because of the yard space gained, but because their use greatly reduces the lightning and other fire hazards.

Honorable Overalls

Concrete wants to introduce to its readers "men on the job." A picture and a brief sketch of a workingman who gives dignity to overalls will help to keep the balance true with the white-collared executives. Is there a pair of "honorable overalls" in your organization?

Mineral Colors in Concrete

A Review of German Investigations

By F. A. Brackmann
Berlin

At a time when the American Concrete Institute is fostering a study of mineral colors by a special assignment to its new committee on Concrete Roof Tile, it is interesting to learn that similar studies are being made abroad.—*Editor*

Coloring cement and concrete is receiving the attention of manufacturers in this industry, but the great number of bad tiles and other goods that can be seen everywhere show that many firms are not familiar with the properties of the colors they are using. Cement has been standardized, and its properties have been studied, but in its relation to mineral colors little head-way has been made. Some interesting articles on this subject by Dr. Platzmann are being published in several trade papers in Germany. He is advocating the establishment of an authoritative committee for the study of the problems of coloring cement and concrete and for the standardization of the mineral colors, on which the color and the cement industries as well as the laboratories in these lines should be represented. He also makes some proposals in regard to working out such an investigation.

An examination of colors should be made in three directions, physically, chemically and analytically. Besides the chemical properties of a color there are several other points of a mechanical and technical nature which influence its quality. The fineness of grinding, constancy of volume, the tendency to efflorescence, resistance to the cement, ability to keep the original tone, the power to color, and indifference to the weather are some of the points that have to be observed in determining the quality.

The finer a color is ground, the greater is its coloring ability, and its proportion to the cement can be reduced. To insure a thorough mixing, the color should at least be of the same fineness as the cement. This is easily tested with the aid of the usual sieves.

It must also be proved whether the color is detrimental to the constancy of the volume of the concrete, as is often the case if it contains plaster of paris or a great part of sulfur trioxide. This may readily be ascertained by mixing five parts of cement possessing constancy of volume with one part of color and about 24 to 32 % of water to a tough paste which is proved in the ordinary way.

To test the tendency of a color to efflorescence a paste is made of it with distilled water. After the evaporation of the liquid, efflorescence will appear at the edge if the color is of inferior quality.

Its ability to resist the action of the lime, the alkaline ingredient of the cement, is generally seen during the test for constancy of volume. A simple test can however be made by mixing two pastes of the same color, one with an addition of lime, and the other without, and observing the ultimate difference in the tone of the color.

An examination in regard to durability under the influence of light takes some time, unless a special artificial light is at hand. With the addition of a little gum the color to be tested is spread onto a piece of paper. One half of it is put into a photographic frame and exposed to the sunlight, the other half kept in the dark. A difference in the two halves reveals after a time the inferiority of the color in this respect.

The following simple means have also served admirably in a lot of instances to judge the coloring ability. A color the physical properties and analysis of which are known, is mixed with zinc-white in proportion of 1:0, 1:1, 1:2, 1:5, 1:10, 1:50, and is spread with a little gum on a white sheet of paper. Other colors that are to be tested are made up in the same way and compared with the standard preparation. Tests in regard to resistance to the weather take a long time and are troublesome, owing to the impossibility to observe all the varying conditions.

The second category of tests requires some knowledge of chemistry, and at least a small laboratory. Cement colors must be mineral colors; they should contain but very small quantities of sulfur trioxide and chlorine ions, and should be insoluble in water. Organic colors may not be used with cement as they cannot resist the action of the lime in the cement. Whether a color is organic or mineral is quickly determined by heating it on a sheet of platinum in the flame of a blow lamp. Mineral colors should not be volatile. Alterations in the tone or an entire change as takes place in the case of ultra-marine green, etc., are immaterial to the test. Mineral colors may be pure earth colors or derivations of such, which are either produced chemically or won from a by-product, or they are artificially assembled. Ocher and umber belong to the first category, iron-oxides to the second, and ultra-marine colors to the third.

To examine the color in regard to sulfates or chlorides which may lead to efflorescence and expansion, it is treated according to the respective salt it contains. Salts difficult to dissolve, especially in colors mixed with gypsum, are rendered soluble with muriatic acid.

Soluble sulfates and chlorides are usually bound to the alkalies. Sulfuric acid is detected with barium chloride, muriatic acid with nitrate of silver. If the precipitation of sulfate of barium and chloride of silver is more than a slight cloudiness the quantity has to be determined, which must however not be more than 2.5% of sulfur trioxide or chloride.

Alkalies or calcium are determined with the help of a spectroscope. In order to test whether a color will dissolve in water, it is washed in distilled water, heated till boiling, and filtered off afterwards. The filtrate should be colorless and leave no residues if boiled down.

The analytical method to examine colors requires a well equipped laboratory and considerable time, but gives valuable and reliable information about the respective colors. This is of importance as they vary according to origin and manufacture and the amount of gypsum, chalk, spar, brick-dust, shale, etc. that is sometimes added. Some manufacturers add considerable amounts of gypsum to their colors, especially to iron oxides, and some red colors which are made out of the residues of the vitriol and alum production have considerable contents of sulfur trioxide. In each analysis the amounts of silicic acid, alumina-ferric oxide, lime, magnesia, sulfur trioxide, sulfide, and loss through burning have to be ascertained. Different colors require, however, special definitions. To determine the strength of ferric-oxide colors, the contents of alumina and ferric-oxide have to be determined. To precipitate the latter the Treadwell method with solution of potash or the method of titration is employed. Alumina is precipitated out of alkali solution with ammonia.

Black manganese colors have to be examined in regard to manganese oxide with acetate of soda or hydrobromide. Ultra-marine colors should contain only a very small amount of gypsum. With chrome colors the amount of oxide of chromium is to be ascertained. The solution contains the chrome in the form of alkaline chromate and is precipitated with nitrate of mercury.

The following table gives a survey of colors and the way to analyze them:

Name of Color	Muriatic Acid	Solution of Caustic Soda	Sulfide of Ammonium	Burning
Red oxide of iron	Slowly dissolv. yellow	Yellow solution	Turning black after long contact	Dark brown
Ocher, umber	Dissolv. yellow, white residue	Yellow solution	Turning dark till black	Red brown
Chromate of zinc	Orange during boiling	Dissolving		Pearl chrome
Coal black	Unaltered	Turning brown	Unaltered	Burns up
Ultra-marine green	Color destroyed develop. sulfur hydrogen	Unaltered	Unaltered	Turns blue
Green oxide of chromium	Slowly dissolv. yellow	Unaltered	Turning into a dull green	Unaltered
Green earth	Hot dissolv. greenish-yellow	Unaltered	Unaltered	Red brown
Ultra-marine blue	Color fading develop. of sulf. hydrogen	Unaltered	Unaltered	Unaltered

The price of oxide of iron colors varies according to the contents of ferric oxide, which are between 40 and 100%. Ocher and umber are cheaper, as the cost of their production is low. They are, however, of comparatively little coloring strength. Zinc-yellow is very expensive and therefore seldom used. Ultra-marine colors require careful handling when used with cement as they have a tendency to cause efflorescence.

Manganese black is produced from manganese ore, and coal black is generally powdered coal. The latter should be especially observed in regard to fineness, as an insufficiently ground color is likely to lead to efflorescence.

It is always risky to use ferric oxides with a lower content than 70%. The higher the percentage, the less color is necessary with a certain mixture, and it pays with all colors to use a better class manufacture and take smaller amounts if a lighter color is to be attained, instead of employing inferior brands.

As all colors except the ultra-marines are decreasing the strength of concrete, this is another reason to employ only first class materials, as only a small quantity of them is required to achieve the desired coloring effect. The ultra-marines increase the strength of concrete. They contain a comparatively large amount of silicic acid which forms silicates with the lime in the cement. With cement insufficiently burned, the silicic acid is diminishing the possibility of efflorescence due to free lime.

Only a mechanical mixing of color and cement insures uniformity in the ultimate product. The water should not be added before the dry materials have been thoroughly mixed.

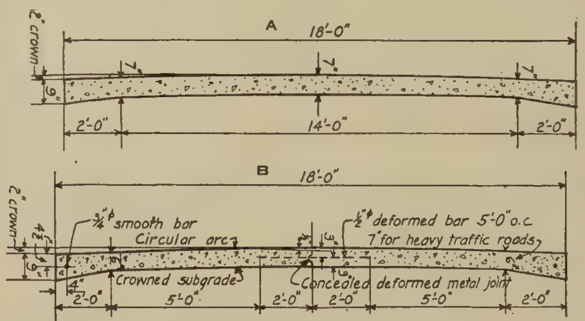
Concrete Roads With Thickened Edges

From the Portland Cement Association's *Concrete Highway Magazine*

The thicker-at-the-edges design for concrete pavement, though it has been used in a modified way in the earlier days of concrete road building, has only recently been accepted as an important improvement in concrete pavement design. Since its first extensive use in Maricopa county, Ariz., the thicker-at-the-edges section has proved its worth in the Pittsburg Test Road; its necessity was demonstrated in the Bates Experimental Road and it has been adopted, with slight variations as the standard design in several state and county highway departments.

Probably the first concrete pavements with heavier edges were built in Wayne county, Mich. The thickened edge was in reality an inverted curb which was placed to provide additional strength at the edge where the corner was rounded to make it easier for vehicles to get on and off the pavement. Other examples of the use of inverted curbs or beams under the edges of concrete pavements were found in California, in Cuyahoga county, Ohio, and Chautauqua county, New York. In all of these cases, the additional support at the edges was provided to meet some particular condition, such as an especially insecure subgrade. They constituted a special precaution and were not considered necessary under ordinary conditions.

The general trend in standard road sections was in the opposite direction—thicker at the center than at the edges. This was probably caused by the desire to get away from the crowned subgrade which was more difficult to construct accurately and which was thought by some engineers to be responsible for the formation of longitudinal cracks. But it was soon found that one of the most prolific sources of trouble was the tendency of concrete roads too narrow for the volume of traffic to be served to break at the edges and at the corners of slabs. Added strength given to the center of the slab seemed misplaced in view of the greater volume of traffic forced to travel near the edges.



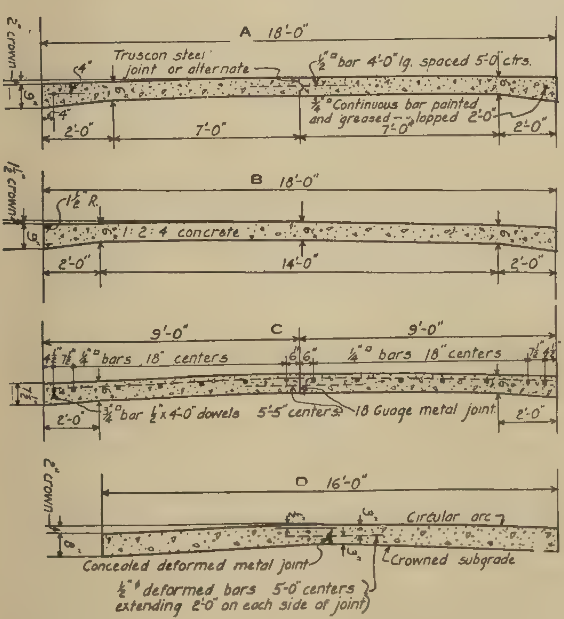
Typical Paving Sections. A—Granville Island, Vancouver Harbor. B—Standard Section Illinois Division of Highways

Maricopa county, Ariz., was the first to undertake, on a large scale, the construction of concrete pavements having thickened edges. The section adopted became known as the Maricopa section and was selected as standard for that county's 309-mile concrete highway system which was begun in 1920. How well the Maricopa section served traffic is shown by a recent thorough inspection. There was an almost complete absence of corner breaks in spite of the fact that as soon as the pavements were opened to traffic, they were used by heavily loaded material trucks weighing about twelve tons which traveled on the extreme edge of the pavement.

While the Maricopa county pavements were under construction, a test road containing thirteen different designs of concrete pavement was being constructed at Pittsburg, Calif. Four sections were constructed with thickened edges and one of these was of the Maricopa design. The road was subjected to intensive traffic so that the behavior of the various designs could be studied and compared. It was found, among other things, that the edges of the slabs appeared to be the most vulnerable places and that most of the breaking started at the edges or the joints. Sections with thickened edges made the most favorable showing in spite of the fact that these were built without reinforcement.

Tests made at the Bates Experimental Road near Springfield, Ill., under the direction of the Illinois Division of Highways, substantiated the findings at Pittsburg. In the Bates Road 63 sections of various types and designs were subjected to traffic and the results carefully studied. Though there were no sections with thickened edges in the Bates Road, the test showed conclusively the need for greater strength at the edges. Commenting on this feature, Clifford Older, Chief Engineer of the Illinois Division of Highways, said:

> Rigid pavements having a uniform thickness or edges thinner than the center are greatly unbalanced in strength and will fail along the edges long before wheel loads are reached which will cause the destruction of other portions of the slab. Although 50 of the original 63 sections of the Bates road either were completely destroyed, or sustained decisive local breaks, not one case of serious partial or complete failure of a rigid section occurred that was not directly due to the lengthening and widening of one or more small broken corner areas.
>
> The comparative absence of destruction along the north edge of the road where the wheels, except during the first and a portion of the second increments, traveled three feet from the edge is striking. * * * Increasing the edge strength of pavements of ordinary width should therefore be of first importance in design.

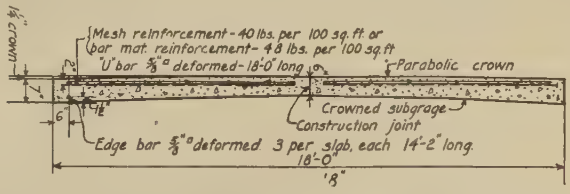

2" crown
A 18'-0"
Truscon steel joint or alternate
4"
½"ø bar 4'-0" lg. spaced 5'-0" ctrs.
6"
4"
¾"ø Continuous bar painted and greased—lopped 2'-0"
2'-0"
7'-0"
7'-0"
2'-0"
1½" crown
B 18'-0"
1½" R.
6"
1:2:4 concrete
2'-0"
14'-0"
2'-0"
9'-0"
C
9'-0"
4½" 7½" ¼"ø bars 18" centers
6" 6"
¼"ø bars 18" centers
7½" 4½"
7½"
2'-0"
¾"ø bar ½"x4'-0" dowels 5'-5" centers
18 Guage metal joint
2'-0"
2" crown
D 16'-0"
Circular arc
8"
6"
6"
Concealed deformed metal joint
Crowned subgrade
½"ø deformed bars 5'-0" centers extending 2'-0" on each side of joint

Typical Paving Sections. A—Utah State Highway Commission. B—Maricopa County, Ariz. C—State Highway No. 40, Tarrant County, Texas. D—Delaware State Highway Department

On the strength of these experiments, backed by the results at the Pittsburg Test Road, the condition of the Maricopa county pavements and theoretical computations, the Illinois Division of Highways changed its standard concrete pavement sections from a 7-in. uniform thickness to the cross section shown in the accompanying illustration, having a thickness of 9 in. at the edges and tapering to 6 in. two feet from the edges. For roads to carry especially heavy traffic, or for bad subgrades, the central part of the slab will have a thickness of 7 in. with the 9-in. edge.

To verify these conclusions, five new sections of concrete were added to the Bates Experimental Road. Four of these have edges thickened to 9 in. with 5-and 6-in. centers, the other being the old standard section of 7-in. uniform thickness. Truck traffic is now testing these new sections and results to date have convinced Mr. Older that the adoption of the new design was justified.

It is also significant that the new Illinois standards require the same mixture as required for concrete roads (1:2:3½), and identical cross-section for concrete bases for asphaltic tops, including the marginal rods and center joint. For bituminous filled brick, the concrete base is specified to be 6½ in. thick, 1:2:3½ mix, marginal rod, center joint, with a marginal curb 8 in. wide, 4 in. deep, monolithic with the base. For monolithic brick, the base, including the mortar bed, is 5 in. thick, but curbs, marginal rods and center joints are not required.


1¼" crown
Mesh reinforcement - 40 lbs. per 100 sq. ft. or
bar mat. reinforcement - 48 lbs. per 100 sq. ft
2"
"U" bar ⅝"ø deformed - 18'-0" long
6"
Parabolic crown
7"
1½"
6"
Crowned subgrage
Construction joint
Edge bar ⅝"ø deformed 3 per slab, each 14'-2" long.
18'-0"
'8"

Typical Cross Section New York State Highways

Since Illinois has changed to the thicker-at-the-edge section, other state and county highway departments have adopted similar designs. Accompanying illustrations show cross sections now being used by New York, Delaware, Utah, Tarrant county, Texas, and by the Vancouver (B. C.) Harbor Commission. Other highway departments using similar designs are the state of Virginia, the District of Columbia and Caddo Parish, La. While the individual designs of these sections differ in their details, all of them make use of the newly accepted principle that the edges of the slab require greater thickness than the center.

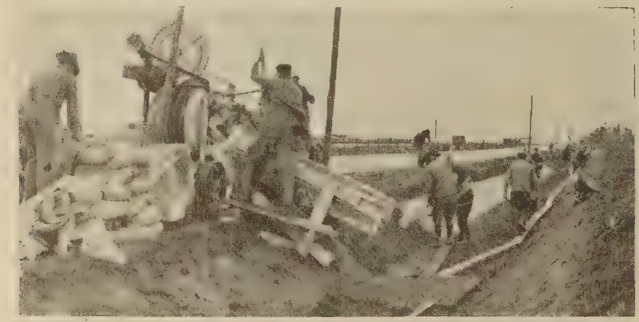
What interesting concrete road job have you done this year? What interesting things have you learned about building concrete roads? Concrete wants to know before November 10.

Economy of Concrete for Irrigation Canal Linings

By R. C. E. Weber

At the conclusion of work of placing concrete lining for the season of 1922-23, there had been placed 755,400 sq. yds. of lining on 79.8 mi. of the canals and laterals comprising the distribution system of the Orland project. The first work performed during 1911 in this connection consisted of lining several high fills on the High Line Canal and various sections, also in fill, of laterals located in fertile black sandy loam, where plant growth was so luxuriant as to require cleaning several times during the irrigation season in order to permit regular water deliveries. The work first performed was limited in extent, but was followed by expenditures from revenues of the original construction charge of the project, which provided for lining about 30 mi. of distributary channels. The results of the lining thus placed were so satisfactory that, with the realization of inevitable high maintenance costs unless a comprehensive program of lining was adopted, the Orland water users in 1917 entered into a supplemental agreement with the Secretary of the Interior, agreeing to an increased building charge of $11 per acre to be expended in placing concrete lining. Construction under this supplement agreement was subsequently commenced and has since been prosecuted each winter season, the work being performed after the close of the irrigation season in the fall and prior to its beginning in the spring. There still remains unexpended from the supplemental revenue sufficient funds for lining 10 mi. of laterals, so that at the conclusion of the supplemental work 90 of the 148 mi. or 60% of the project distribution system will be lined with concrete.

Comparative costs of maintaining the earth and concrete-lined sections are available covering a season's work of cleaning 66 mi. of the former and 31 mi. of the latter, from which is obtained a cost of $55.70 per mi. for earth and $19.50 for concrete-lined sections. The data apply to laterals of an average capacity of 25 second-feet. A reduction of 65% in the maintenance cost of earth laterals results from the use of concrete lining, and this may reasonably be expected to increase as the system is more and more comprehensively lined. The work of cleaning earth sections is performed with teams and scrapers and consists in the removal of silt deposits and all plant growth. The maintenance work in connection with lined sections consists of the removal by hand of the small silt deposits and of making minor repairs to the lining.



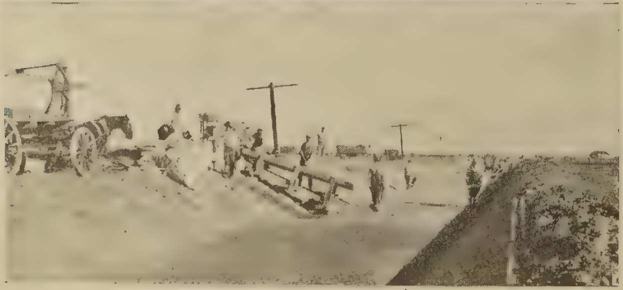
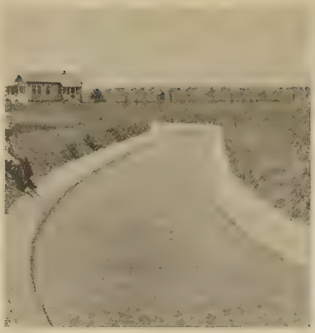


Fig. 1—Placing Lining on Lateral System

Fig. 2—Placing Lining on South Canal



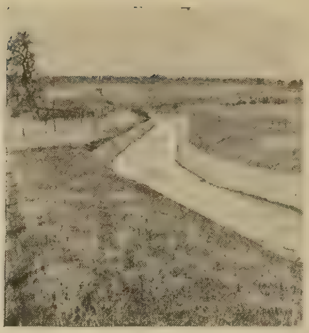


Fig. 3 (Left)—Concrete Lined Lateral

Fig. 4 (Right)—Lined Section South Canal

A reduction in seepage and evaporation losses is an additional factor in favor of the concrete-lined section. By means of current-meter measurements and discharges over weirs, seepage and evaporation losses of laterals located in the different soil types of the project and in concrete-lined sections have been determined during each irrigation season from 1912 to 1922, the means of which are tabulated as follows:

Type of section	Loss in feet per day of unit of wetted perimeter
Concrete lining	0.29
Clay	.63
Gravelly clay	1.38
Loam	1.40
Gravelly loam	1.47
Sand and gravel	2.85

From the foregoing tabulation a material reduction in seepage and evaporation losses (as much as 90% in sand and gravel sections) is possible by the application of concrete lining to the earth section. Another important factor in favor of the concrete-lined section over the unlined channel in earth is that of the increased degree of operating safety as a result of the comparative freedom from washouts and breaks, with the consequent expense for repairs and possible great crop loss resulting from an interruption to regular water deliveries.

The irrigable area of the project is 20,500 acres, of which 15,000 acres were under irrigation during the season of 1922 and which was all served, either directly or indirectly, through concrete-lined channels. With the exception of about 4,000 lin. ft. of the South Canal (which it is deemed impractical to line on account of winter ground-water conditions), all the canals on the project distribution system, together with all laterals of capacity in excess of 25 second-feet, have been concrete lined. There remain unlined, therefore, only laterals of less than 25 second-feet capacity, and these consist mainly of secondary laterals or constitute the extremities of primary laterals where water is delivered only intermittently on the regular rotation periods.

The cost for all concrete lining placed on the distribution system of the project is 38.9c per sq. yd. for 755,400 sq. yds. placed on 79.8 mi. of canals and laterals with capacities varying from 10 to 225 second-feet. The period of time over which this cost was incurred extends from 1911 to 1923, during which there has been a large variation in price of materials and wages of labor, as illustrated by the maximum of $4 per day of eight hours for labor in 1920 to a minimum of $2.24 in 1911.

Cost of Concrete Lining Placed During Season of 1922-23, Orland Project

Item of Cost	Total cost	Cost per square yard
Preparing section for lining	$5,914	$0.076
Cement (including hauling to field)	10,129	.130
Gravel	3,921	.050
Mixing	1,944	.025
Placing	3,253	.042
Finishing	414	.005
Sprinkling and protecting	130	.002
Water	327	.004
Repairs and supplies	277	.003
Equipment charge	365	.005
Total labor and material cost	26,674	.342
Superintendence	177	.002
Engineering	509	.007
General expense	3,498	.044
Total overhead cost	4,184	.053
Total cost	30,858	.395

Quantities

Item	Unit	Quantity	Cost per unit
Lining	Square yard	77,919	$ 0.395
Concrete	Cubic yard	2,882,7	10.70
Lateral lined	Mile	9.05	3.410
Lateral lined	Linear foot	47,776	0.646

Thickness of lining, 1½ inches.
Average haul: Gravel, 1¾ miles; cement, 4¼ miles.
Labor costs per day: Finishers, $4.75; placers, $4; laborers, $3 to $3.50; teamsters with 2 horses, $5.50.
Cement (at project warehouse), $2.80 per barrel.
Sections lined: Bottom width, 3 to 15 feet; vertical height, 1.5 to 4.75 feet; side slopes, 1½ to 1 and 2 to 1; capacity, 15 to 75 second-feet.

With labor and material prices as those prevailing prior to 1916, concrete lining has been placed at a cost of 34.3c per sq. yd., 27.8c of which was for labor and material and 6.5c for overhead charges, consisting of general expense, engineering, and superintendence. The average labor wage for lining placed at the foregoing cost was $2.50 per day for laborers and $4.50 for teamsters with two-horse teams. Cement cost was $2 per barrel. As there is little hope to be entertained that prices in the near future for labor and materials will approach the foregoing low cost figures, the detailed analysis above is submitted for of lining placed during the season of 1922-23 with a view of illustrating probable costs for future work of this nature.

With regard to the durability of lining of 1½-in. thickness without reinforcement it can be said that lining placed in 1911 and in continuous use each irrigation season since is still in excellent condition, with no indications of disintegration or failure. The mild California winters in the Orland vicinity, where temperatures reach only a minimum of 21° above zero make possible the use of an extremely thin slab of concrete for lining purposes.—*Reclamation Record.*

If you had an idea and used it successfully—give it away to somebody else—a hundred somebody elses will reward you with their ideas through these pages.

Concrete Chimney of Precast Segments

A precast reinforced concrete chimney built on construction methods which originated in Belgium has just been completed at Newcastle-on-Tyne, England, for the Co-operative Wholesale Society Ltd. It is 150 ft. high with an inside diameter at the top of 5 ft. and weighs less than 200 tons.

A brick chimney of the same dimensions would weigh twice as much and would have cost about twice as much to build, it is claimed, while a further advantage attributed is that the weight of the foundations required was greatly reduced.

The method of construction consists in molding a certain number of reinforced concrete segments and bedding them one on top of another, very much the same as in masonry work. The segments are about 1 ft. high by a thickness which varies according to the height. The special shape given to the segments, which have a kind of reinforced concrete hook at one end, is the principal feature of the individual segments.

A pleasing appearance is produced by the fact that the various heads or hooks of the blocks form a continous longitudinal rib where the joint is formed at each corner. The rib is made for the purpose of accommodating the vertical bars which form the principal reinforcement of the chimney shaft, and which are provided in sufficient numbers to counteract any tension which may occur in the chimney due to wind pressure. The tapering of the shaft is produced by gradually reducing the length of each block or segment as the work proceeds upward.

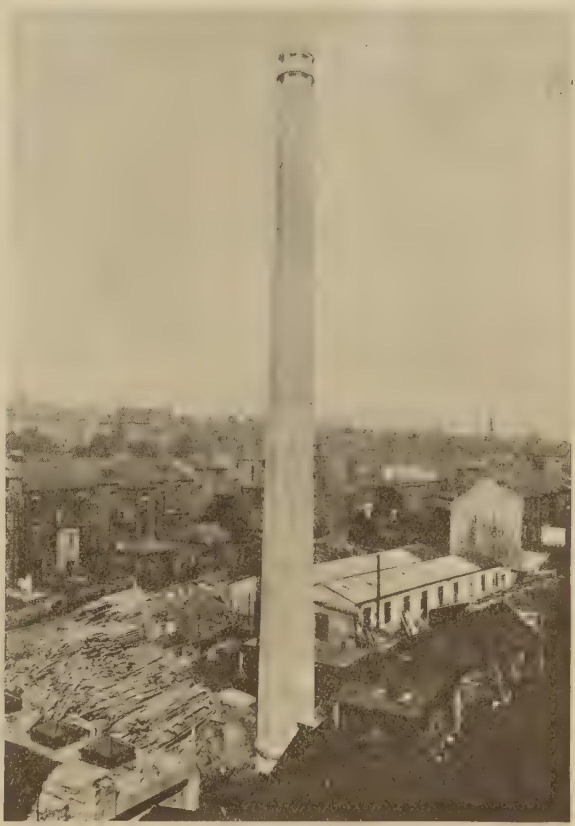


Fig. 1—Completed Chimney 150 ft. High Constructed of Precast Units

Construction of chimneys by this new method requires no centering or scaffolding, as practically the whole of the work is prepared on the ground by precasting the blocks or segments in cast iron molds which can be used repeatedly. Only 40 molds were required for the construction of the chimney, although 1,414 segments were used. Special wooden molds were prepared for precasting the special blocks forming the last 10 ft. of the chimney at the top, where decorative moldings were introduced to enhance the appearance of the chimney.

A special feature of this method of chimney construction is that the whole work can be carried out from the inside of the chimney by means of movable steel put plugs. The blocks were hoisted by means of a pulley and placed in position without any difficulty.

The principal reinforcement, which consists of round bars gradually overlapping each other within the height, is situated well away from the inside of the chimney and consequently as far as possible from the heat; whereas in monolithic chimneys the bars are usually placed circumferentially half-way through the thickness of the reinforced concrete walls where they are more liable to the effect of the heat. The segments are reinforced by means of small round bars, and the thickness of each segment within the height is calculated in every case to withstand the compression due to the dead weight and the wind pressure.

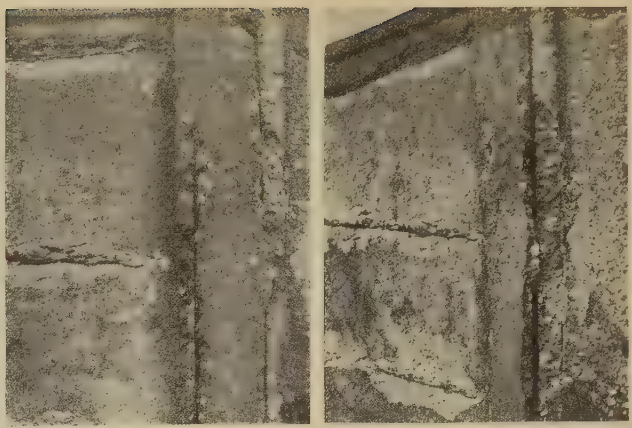
Each complete ring of segments is bedded on the top of the lower one by cement mortar, a groove being left in the lower segments to accommodate a circular bar or ring, which has the effect of tying together all the segments of each ring. While the chimney is of light weight the method of construction is calculated to give considerable strength.

The foundations of the chimney, which are octagonal in shape with a radius of 12 ft., are composed of a reinforced concrete raft 18 in. thick, with counterforts at each corner of the octagon. The raft is supported by a mass concrete bed 2 ft. thick. The total height of the foundations is 7 ft. The precast segments start from this level and a rectangular opening is left for the flues. The top and sides of the opening are heavily reinforced. The total distance from the ground level to the underside of the foundation is 19 ft.

In order to prevent the reinforced concrete from being affected by the heat, a brick lining was provided of an average thickness of 14 in. for the first 20 ft., 9 in. for the next 10 ft., and 4½ in. for the following 10 ft. A maximum airspace of 2 in. was provided all around the brick masonry. In order to admit air between the brick lining and the reinforced concrete shaft, eight ventholes were made at ground level.

The precast blocks can be arranged for hexagonal, octagonal or pentagonal chimneys. The chimney was constructed on the Monnoyer patent of France and Belgium, of which only a few have been built in England. W. G. Townsend Gray was the company's architect, and the whole of the working drawings were prepared by Messrs. Edmond Coignet, Ltd., London, W. C. 1, England.

Detailed Report on Tucker County (W. Va.) by David B. Reger, issued by West Virginia Geological Survey, Morgantown, W. Va., containing 542 pages and XVIII pages of introductory matter; illustrated with 16 half-tone plates and 11 zinc etchings in the text, accompanied by a separate case of topographic and geologic maps. Price, delivery charges prepaid, $3.00. Extra copies of Topographic Map, 75 cents each; of the Geologic Map, $1.00 each.



Destruction of Concrete Due to Rusting Reinforcements

By E. Lee Heidenrich

The illustrations by Dr. Kleinlogel in a recent issue of *Beton u. Eisen*, show that German concrete constructors have the same trouble that we have with our exposed concrete bridge railings and the like, a deterioation due to the effect of weather and moisture on the reinforcement.

Dr. Kleinlogel suggests repair by cleaning the steel where it is rusted and by covering the surface by means of the cement-gun.

On the principle that prevention is better than cure, the writer would and does specify that sufficient hydrated lime be used in the mix for exposed surfaces to reduce the capillary action of the concrete to a minimum (between 5% and 10% of hydrated lime), and that a cement paint be applied to the finished surface to fill the surface pores and thus seal them against the possible attack of the weather.

Floating Dry Dock of Reinforced Concrete

Tonindustrie-Zietung

The Mindener Concrete Ship yard at Minden, Westphalia, some two years ago, completed a floating dry dock 260 ft. long, 32 ft. 6 in. wide, and 11 ft. 4 in. high with 2 in. thick walls. The light draft is 16¾ in., and it was built in 6 weeks. Several boats have been built in this dock, especially the 800-ton dead weight "Aquilla I," a concrete ship 220 ft. long, 27 ft. beam and 8 ft. 4 in. deep.

The Lloyd List estimates the cost of maintenance of the concrete dry dock at ¼ to ⅕ of that of a steel dock of equal capacity. The concrete dock is so constructed that its several units can dock themselves, but owing to rust proof qualities of the dock this has not as yet been required.

Besides strength, a very light draft is required of these docks. For several years the Mindener Concrete Ship yards have been using concrete lighters or barges with a light draft of only 7½ in. Seven pontoons 50 ft. long, 6 ft. 6 in. wide and of exceedingly light draft were employed by the firm in building a bridge for the Municipality of Minden.

For nearly two years a concrete ferry has been in commission at Petershagen a. d. Weser. It is 52 ft. long, 18 ft. beam, and 3 ft. 3 in. deep, having a draft of only 11½ in.

Graded Aggregate: News, Review, Hearsay, Comment—A Department of Fragmentary Miscellanies—the material for which will be gathered from the job, the office, the factory, over the lunch table, in Pullman smokers, from the morning mail and many other sources.

THE ESTIMATED COST OF STRIKES in the United States last year was about $2,500,000,000 or thirteen times the cost of the Panama Canal, according to the Association of Building Trades Employers.

* * *

Don't Crowd, Boys

The United States Civil Service Commission announces a competitive examination for architectural draftsmen, November 7 and 8, to fill vacancies in the Departmental Service, at entrance salaries ranging from $1,500 to $2,000 a year (plus increase of $20 a month granted by Congress). Applicants must have been graduated in architecture from a technical school of recognized standing or have had at least five years' experience in progressive architectural office drafting work.

* * *

A Block Laying Kink

"Here's a kink," writes M. J. Johnson, St. Paul, Minn. "In laying block basements, garages, etc., when within three or four courses from the top start in one corner on inside, two or three inches down on the block and level from that point both ways around and mark in each corner, then nail a small wood block in each corner to measure from in laying the rest of the courses. That requires but one leveling and enables the block layer to get the walls exactly level."

* * *

A SMOOTHLY FINISHED CONCRETE FLOOR MAY BE MADE AN ACCEPTABLE SURFACE FOR DANCING by sprinkling it with boric acid in dry powder form. Sweep off the surplus to prevent it rising later as a dust. Or you may use talc dust; it is almost as good as boric acid. This suggestion comes from J. C. Pearson, Chief Cement Section United States Bureau of Standards.

* * *

Efflorescence?

Efflorescence—What and why? Again someone has asked. Usually efflorescence is chiefly calcium carbonate.

It is generally caused by the leaching of lime salts from the mortar or concrete due to the moisture within coming to the surface and carrying in solution, usually, calcium hydroxide. This is commonly turned to calcium carbonate from the carbon dioxide in the air. There may be a trace of calcium sulfate due to the small amount of gypsum contained in the cement and under certain locations other salts might be found in the whitish deposit which is usually termed efflorescence. It is minimized or prevented in proportion as the work is non-absorptive.

Is the Colorimetric Test for Sand Always Reliable?

"In making a sand test recently, it was noticed that the colorimetric test, described by the A. S. T. M. under serial designation C-40-22, showed a very dark discoloration equivalent to Figure 5," writes F. K. D. in a letter to CONCRETE.

"The sand, however, appeared to be clean and free from loam and had a fineness modulus of 3.03.

"A mortar test of 1:3 mix was made and the sand developed a strength of 65% greater than standard Ottawa sand.

"When a further examination of the sand was made, it was found to contain small particles of lignite. These particles, when subjected to a 3% solution of NaOH, produced the same very dark color mentioned above. It is evident that lignite does not appreciably affect the strength, but the humus test would cause the discarding of this sand as unfit for concrete work if a mortar test had not been made."

* * *

CONCRETE FLOOR SPECIFICATIONS of the American Concrete Institute (adopted as tentative at the convention in January, 1923) are the basis of a new publication of the Portland Cement Association entitled "Concrete Floors." 16 pages, 8½ x 11 in. The publication also presents a brief consideration of heavy duty floors, terrazzo floors, dance floors, colored floor finish, floor treatments, floor coverings and typical floor designs, with quantity tables.

* * *

Better Tools Bring Higher Wages

Samuel Gompers tells the Unions (an article in *The American Federationist*) it is futile to protest against the introduction of new machinery or tools. He recalls his own futile strike many years ago against the introduction of molds into the cigar making trade; he recalls how in the textile industry, men were enraged because the spinning jenny seemed to take their jobs away from them and destroyed the machine, which was replaced by others; he recalls that the water carriers of Egypt protested against pipe lines and the Chinese rickshaw runners fomented a revolution when horses were attached to wagons. He recalls that only when wages are high are machines brought in and that the typesetting machine has boosted wages, shortened hours and improved printing conditions. In closing his remarks, he "asks anybody whether he knows of a trade where the union has recognized the machine or improved tool where conditions of the working people were made worse."

* * *

Sidewalks and Steps

"To build good sidewalks," writes John J. Page, Uniondale, Pa., "make bed up to within 4 in. of top of rail; lay one-ply tar paper the length and width of walk; put in dividers; put in concrete. At end of six months every flag can be taken up and shipped if desired. Never use trowel—float them and leave the float marks a little rough. If concrete is put into open spaces, say 6 ft. long, the bed is of rocks or hardpan with at least some porous earth, and the wet concrete goes down into this earth probably 12 or 14 in. So the flag is 12 or 14 in. in one place and 4 in. where the hardpan or boulder is; when frost comes, the flag will break on the 4-in. hardpan place, for it will give there before it will in the 12- or 14-in. depth. By using paper the depth is uniformly 4 in. and will lift and lower with the frost and always be a walk that you won't be ashamed of.

"Steps—first, base for side pieces to rest on; next day, side pieces are put up and finished; then steps are put in. Everything is done separately, and should the frost come, no part of the work is affected."

* * *

The Lighting Standards Selected for the Lincoln Highway Ideal Section are of reinforced concrete, hollow, "spun" by the centrifugal process by the Massey Concrete Products Corp. They are high enough to put the light 35 ft. above the ground. The concrete is made with red Wisconsin granite, the reinforcement a cage consisting of longitudinal rods with spiral wire wrapping. When cured the posts are acid-washed to reveal the aggregate.

* * *

William Henry Merrill

William Henry Merill, founder president of Underwriters' Laboratories, Inc., died Monday, Sept. 17, at the Presbyterian Hospital, Chicago. Born in Warsaw, N. Y., December 29, 1868; graduated Massachusetts Institute of Technology in 1889 and shortly after reported in Chicago for service in fire protection and prevention. In 1898, he organized the Underwriters' Laboratories and has since served as its principal executive. The institution both as to its plant and its equipment and its influence in the building and manufacturing industries becomes an enduring monument to his talent as an organizer and executive and as a crusader in a public work of major importance.

He served in turn as secretary-treasurer and as president of the National Fire Protection Association, and was later elected to honorary membership. In 1918, he was drafted for war service at one dollar per year, serving as chairman, Fire Prevention Section, War Industries Board. Mr. Merrill was a member of the Mid-Day and University Clubs of Chicago and of the Sigma Chi college fraternity. He is survived by a widow and five children of a former marriage.

* * *

Standard Sizes for Block and Brick

Concrete products manufacturers and the Division of Simplified Practice, Department of Commerce Conference, have joined in a report recommending:

That standard sizes of concrete brick be the same as adopted for clay face brick: Rough, 2¼x3¾x8 in.; Smooth, 2¼x3⅞x8 in.

That the tentative standard sizes for concrete block and tile be as follows:

Foundation Concrete Units—Height, 7⅝ in., Length, 15⅝ in.; *Wall Thicknesses*, 8 and 12 in. (thickness of units); *Load Bearing Wall Concrete Units*, Height, 7⅝ in., Length 15⅝ in.; *Wall Thicknesses*, 6, 8, 10 and 12 in.; *Load Bearing Wall Concrete Structural Tile*, Height 5 in., Length 11⅝ in.; *Wall Thicknesses*, 4, 8 and 12 in.; *Concrete Partition Tile*, Height, 7⅝ in., Length, 15⅝, 18 and 24 in.; *Wall thicknesses*, 3, 4, 6 and 8 in.

It will be noted that there has been a departure from the common practice of making an allowance for ¼-in. mortar joints in fixing the actual dimensions of the block. It was believed by the committee that present practice and economies effected thereby argue strongly for a departure from the ¼-in. joint, and that new mold box sizes should be dimensioned accordingly. In connection with this standardization there will be sufficient "tolerance" to permit present sizes of block until the industry can conveniently and without loss or interruption change to the suggested scale of sizes.

* * *

One Hundred Twelve Thousand Dollars Would Be Big Postage to pay on one copy of a technical magazine—even from technically wise Germany. Well, nobody pays that much. Now, when it is all the rage to tell stories of castles on the Rhine that are sold for $19.95 in American money, it is interesting to note that the latest issue of *Tonindustrie-Zeitung* to reach this office bore on its wrapper postage to the amount of 450,000 marks, which at the one-time honored rate of exchange would have been about $112,000. At that time, a copy of this same magazine was prepaid for a few pfennigs—but who can remember a pfennig!

* * *

Motion Picture Enterprise

Motion picture enterprise will now compress the construction operations on a 32-story office building to a 16-minute reel. The Strauss building on Chicago's Michigan Boulevard will be erected on the screen in one reel, just as a flower that is several days in the blooming will blossom forth in the movies, in a few moments. The thing has been tried before but not with great success, because when different scenes were made the camera was in slightly different positions. A fraction of an inch difference in the position of the camera was so magnified on the screen that the general result in continuity was destroyed.

But when the Strauss building was started, a mound was thrown up in Grant Park across the boulevard; stilts driven into it and on top of the stilts a camera house built. The tripod was secured to the floor and the camera bolted onto the tripod so that it could not move a hair's breadth. This movie equipment will remain as it is until the building is completed and every morning the cameraman mounts to this house on stilts and cranks a few feet of film. Next year's engineering school students can behold a $15,000,000 building go up in sixteen minutes. The film will also be available to engineering and architecture organizations, contractors' conventions, etc.

* * *

Uses for Pulverized Limestone

In the progress of a study of methods of utilization of waste rock at lime-plant quarries being conducted by the Department of the Interior, through the Bureau of Mines, it has been found that limestone pulverized to a much finer grained form than for agricultural use is finding wide application in various products. Small quantities may be added to stock food as a bone builder. A dust approximately 80% of which will pass a 200-mesh screen is the most widely used filler in road asphalt surface mixtures, though slate flour and portland cement and hydrated lime are used to some extent.

Ground limestone is used to a limited extent as a fertilizer filler. It has the advantage over inert fillers in that it has valuable properties as a soil conditioner. Very finely pulverized limestone may be used successfully as a whiting substitute in certain classes of rubber, paint and other products. It is essential for such uses that it be very finely ground and uniformly sized so as to exclude all comparatively large-sized grains. In general, a limestone flour that will successfully meet the requirements of fillers of a type like whiting or china clay should approximate 300-mesh size. Few lime-plant quarries have the equipment for grinding or sizing to this degree of fineness, and have, therefore, been able to utilize this promising field of application.

* * *

AMERICAN STEEL-CONCRETE BUILDINGS IN TOKYO AND YOKOHAMA WITHSTOOD THE EARTHQUAKE SHOCK and are in good condition, according to a cable from Assistant Trade Commissioner G. C. Howard at Kobe, to the Department of Commerce. Officials expressed gratification over the first practical demonstration of the effectiveness of the new so-called earthquake-proof factories and office buildings which have been constructed within the past three years. There are about six of these buildings in Tokyo. The fact that this construction has proved earthquake-proof is likely to influence favorably the adoption of this type of construction in the future.

* * *

Test Fire Resistance of Roofs

An investigation to determine the fire resistive values of different types of roofing materials, including for the present wood shingles and the lighter forms of prepared roofing and shingles, is in progress at the U. S. Bureau of Standards. The investigation may be extended to include the heavier types of prepared roofing, built-up roofings, as well as metal, tile and slate roofings.

The present tests to which they are submitted include the brand tests where lighted brands of certain standard sizes made of strips of shingles are placed on the test decks, over which wind velocities of six and twelve miles per hour are produced by a propeller fan. Flame tests are also made where the deck is subjected to a sheet of flame for its entire width and other decks are placed near the burning deck to receive the brands produced, if any. Brand tests will also be made in connection with hot blasts representative of conflagration conditions. The test decks are generally dried at 40 to 45° C. (104 to 113° F.) in an electrically heated drier, these temperatures being representative of conditions on roofs in dry summer weather. Tests will also be made of decks in the ordinary air dried condition and also of samples of roofing that have been aged and weathered for a period of years, the object being to obtain the efficiency of old as well as of newly laid roofing.

* * *

Effect of Oil-Well Waters on Setting of Cement

The effect of various oil-well waters on the setting of cement is being studied at the petroleum experiment station of the Bureau of Mines, Bartlesville, Okla. Petroleum engineers of the Bureau, in the course of their investigations, are frequently told by operators that the chemical characteristics of waters in their wells are such as to prevent cement from setting.

Where surface tests have been made at these wells it has been found invariably that a good grade of cement, properly mixed, will set in water from the well. This indicates that conditions in the well, such as movements of fluid, agitation by gas, or improper preparation of the hole for cementing, are among the causes for the failure of cement to set.

The Bureau's engineers are not convinced, however, that cement will set in all oil field waters, and therefore are attempting to obtain samples of oil field waters where difficulty has been experienced in securing a proper set. By collecting numerous samples of waters from various fields and making tests with cement it is hoped that useful information may be obtained regarding cement failures in wells.

The Bureau of Mines is requesting oil operators to furnish samples of waters from wells where difficulty has been experienced in securing a proper set, accompanied by information giving location and depth of well and the method of obtaining the sample.

* * *

TO AVOID CRACKS IN A CONCRETE TENNIS COURT, wire mesh reinforcement should be used and but one expansion joint along the net line. Keep the concrete wet all the time by the ponding method or by sand covering for at least a week. To obtain a green color in the court (a correspondent insists upon this color) use a good quality of chromium oxide. This color is expensive so it should be used in a thin topcoat only and this topcoat should be placed before the base concrete has hardened. Use no more than 6 to 8 lbs. of color to 100 lbs. of cement, the cement and color preferably to be ground together before the sand and water are added. Also see the discussion in this department for September of a green hotel floor and how it was made.

* * *

Escape from Desert Isle In Concrete Boat

John Kenlon, chief of the New York City Fire Department, built a reinforced concrete boat under unusual circumstances. An interesting episode quoted from his book "FOURTEEN YEARS A SAILOR," shows that Chief Kenlon, cast ashore on an island in the Indian Ocean, realized the advantages of concrete construction. To quote:

> The thought kept pressing in upon me "build a concrete boat." Consideration of the idea from every angle left no doubt in my mind that a concrete boat would float, for, after all, it is simply a matter of displacement. * * I thought long on the ingredients that go to make concrete. Of sand, gravel and broken stone, we had an abundance; cement, the one essential, was lacking.

Kenlon goes on to say how a primitive kind of lime or natural cement was made from some limestone, and that with this as a binding material, a 32-ft. boat was built. The concrete was reinforced with rope. Continues the narrative:

> Less than half a day was consumed in pouring the concrete for the keel of the boat. We knew it would require six or seven days to harden. Those days were devoted to the most difficult problem we had to solve in our efforts to build. * * As the boat took the water, I can imagine that all hearts stood still only to beat stronger and faster as she lay on the water on a perfect line, just showing the amount of freeboard our calculations had figured out. The cheer that went up could be heard for many a mile. Success! Unqualified success had crowned our efforts! We had built and successfully launched the first reinforced concrete ship that ever floated!

Kenlon writes that in this concrete boat named the *Comet* they covered about 1,600 miles before being picked up by another vessel.

Workingman's Buying Power Greater

Although the rent item in the average family budget in July last was 75% higher than in 1914, other items have dropped and wages increased, so that the "real" earnings of the American workingman are, weekly, 35% higher than then, according to research reports just issued by the National Industrial Conference Board, New York city. It was found that between March and July this year there was an average increase in rents of 3%, although inflation seems to have subsided somewhat in Boston, Buffalo, New York, Baltimore, Philadelphia and Pittsburgh. Washington had an increase in that period of between 11 and 20%. Rent increases which average 100% or more since 1914 were in effect in 32 cities, including Chicago, Detroit, Los Angeles and Milwaukee. As for other family expenses—the net increase in the family clothing bill since 1914 was 70%, and this has been lowered 36.3% in the past three years; food was 47% above the prewar level and, at that, 33% below the July, 1922, peak. The last three years have brought decreases in food, clothing and sundries, and increases in shelter, fuel and light. The outstanding facts are that the cost of living in July, 1923 was 61.9% above the 1914 level, 1.7% of this coming between March and July of this year; and that increased pay and a higher level of hours worked so materially increased earnings that the balance left over the increase in cost of living makes so-called "real" earnings 35% better than in 1914. The Board combined data for a number of industries in order to form a composite trend which should reflect basic movements.

* * *

A CONCRETE TREE is probably better than no tree at all but the real reason for publishing a picture of it elsewhere in these pages is to add some zest to the problem of building a concrete lemon pie. This is a distinct lack to which we have so far been unable to attract sufficient attention. Several years ago this magazine mildly upbraided the industry for its unprogressiveness in failing to come up to the scratch with a toothsome replica of that quivering concoction of the pastry cook—frothy meringue and all, topped off with little amber beads of citrus nectar. The commonplace problems of good concreting can go hang—what we want is to encourage everybody now making rockface block to quit that branch of the "imitation industry" and give us concrete lemon pies.

* * *

Use of Chimney Block in Detroit

Concrete chimney blocks are the subject of frequent inquiry of this magazine from concrete products manufacturers who make them or would make them if their use were recommended.

Such an inquiry was passed along by the Portland Cement Association to Frank Burton, Detroit Building Commissioner, who wrote June 12, 1923, as follows:

> Regarding the use of concrete chimney blocks, would say that these blocks are prohibited by our building code, which requires 8 in. of masonry with terra cotta tile flue lining. Some years ago our Common Council by resolution directed the Department of Buildings to approve the use of these blocks, provided special blocks were furnished for connecting a thimble. Since that time they have been permitted and used to a considerable extent. As far as I know, they have not been the cause of any fire.
>
> Several practical difficulties have been encountered in their use. The first is that frequently the block company neglects to send special thimble blocks with the result that the chimney is built and then a hole is cut through with a chisel, which does excessive damage to the chimney and permits the leaking of flue gases into the triangular corner spaces.
>
> The second difficulty is that the thimble blocks are built in the chimney properly, but do not come the proper height to suit the furnace man. He therefore blocks up the opening left by the mason and provides another, with the consequence mentioned above.
>
> The third difficulty comes from failure of this type of construction to provide any method of installing a cleanout door at the base of the chimney.
>
> We also have difficulty because masons fail to properly mortar up the joints in the inner ring and the mortar bed in the outer square is often inadequate also.
>
> In spite of these difficulties, there are a larger number of these chimneys in use, and are, so far as I know, giving good service. I have no reason to believe they deteriorate, when subjected to flue gases or to heat, and as I stated above, our Fire Department has no record of fires having originated from such chimneys.
>
> I believe it would be well if your Association would study the matter and devise some practical method of installing cleanout doors. Also I believe you should get in touch with the manufacturers of small hot air furnaces and see if it is not possible to work out some rule for the location of chimney openings, as well as for the size of such openings.
>
> Also I think you should undertake a campaign of education to teach masons to use these blocks properly.
>
> If you could accomplish these things, I do not believe there would be any good reason why this type of chimney should not be extensively used in small dwellings.

* * *

THE LITTLE WIRE TIES USED IN FASTENING CEMENT SACKS are being bought in quantities by one of the largest taxicab companies in Chicago, as a part of the skid-chain equipment of the taxicabs. The wires are six or eight inches long and it is the work of but a moment for the drivers to fasten their skid-chains in place with several of the wire ties. Last year over 46,000 miles of wire was made into ties for cement sacks, and it was only natural that in handling this volume the tie makers secured some material that was not exactly suitable for sack purposes. One of the tie manufacturers brought this matter to the attention of the purchasing agent of the taxicab company with the result that thousands of these "seconds" were secured by the taxi drivers to put on their skin chains. A regular market was soon established for the little wires in the taxicab field.

* * *

The Burial Vault Business

It is pointed out by H. A. Williams, manager of the Norwalk Vault Co., of New Jersey, at Plainfield, that it is not always enough to sell the undertaker on his product. Sometimes a cemetery reserves the vault handling privileges to itself, and then it is necessary to deal either with the association or with the superintendent or both and interest them financially. Mr. Williams' company has made such arrangements and makes it a practice to store vaults in the cemetery and allow the superintendent a certain amount for each vault he sets. This is not only satisfactory, in many cases, to the cemetery superintendent, but it works out to the convenience of the manufacturer in not being obliged to make quick delivery to cemeteries many miles away. Before winter sets in, the stock in these storage places is made up and as the stocks are depleted, a fair day is chosen to restock. In making deliveries, it is customary to use two trucks with two vaults on each one. Each driver then helps the other in loading and unloading.

As Mr. Williams' company does not, in any of its work, maintain that its vault is cheap in either quality or price, it is necessary to adopt some means at times to overcome the price consideration. To accomplish this, a profit sharing system has been adopted, by which any undertaker who sells vaults regularly is entitled to increasing percentages as the number of his vault orders mounts up in any one month. The first vault in the month is sold at the regular price, on the second vault, a discount is allowed, on the third vault a slightly greater discount and so on for each vault sold for that particular month.

Just as soon as Mr. Williams' company got on its feet, it adopted the practice of setting aside 6% of its net sales for advertising and Mr. Williams favors using the services of an advertising agency to handle the business as they can do it better. The first advertising done was done in the home paper only and as the money in the fund accumulated, this advertising was broadened to reach the papers of surrounding towns, until at the present time, advertising is carried in a dozen newspapers and several local magazines. Mr. Williams' company business was built up very slowly and had hard sledding. It got on its feet by watching the pennies in many ways. A good foreman who understood the cement business was the first essential. Mr. Williams worked early and late rather than hire extra help. Sometimes extra help was absolutely necessary and then was frequently hired for only a few hours at a time, on an hourly basis, rather than putting on men for several days. As soon as a profit began to show, a bonus system was adopted and then the employees, the business having grown in the meantime, were given a share in the returns. This, Mr. Williams reports to have been an excellent idea in their business. In January 1920, the company began paying dividends to stockholders, outside capital having been brought in, and has been paying 1% a month regularly. This was a year and a half after Mr. Williams took hold. Business has increased from year to year since 1918 at the rate of about 20% a year.

* * *

THE PROGRESS OF TRADE EDUCATION in the United States is the subject of cheerful comment by the National Association of Building Trades Employers in a recent weekly bulletin, in part as follows:

> It is interesting to learn through the daily press that classes for the training of apprentices in the construction industry in hitherto unheard of numbers are being started with the opening of the public schools of the country. A few years ago outside of a number of industrial schools and one or two endowed trade schools it was absolutely impossible for a boy to learn the art of laying brick or any of the other building trades in the classroom. If he wanted to become a doctor, his course was outlined for him almost from the time he entered the grades, but if his mind was set on being a plumber, the public school system did not offer him an equal opportunity. Only 4% of the boys entering the grade school ever graduate from college, yet it seems that the entire educational system of the country has been built up around this 4%. It is wrong to allow one boy to pursue his natural inclinations and refuse to allow another to do the same if his particular ambition in life is to become a carpenter.
>
> The responsibility for the establishment of building trade courses in the schools is very largely up to the contractors. We again urge that local associations of contractors see to it that at least one of their number is on every local Board of Education in the country.

* * *

Cinder Block Men Organize

The National Cinder Concrete Products Association was formed in Philadelphia recently by manufacturers of the Straub patented cinder concrete building block with purposes set forth in the by-laws, "to increase the use of cinder concrete products, assist in upholding their quality, engage in research work for the improvement of the methods of manufacture, encourage the enactment of adequate and reasonable legislation relating to the use of the products, and work in every way for the advancement of the industry generally." A rapid growth of this branch of the products industry seemed to necessitate an organization for the mutual exchange of opinions, experiences, troubles, successes to reduce mistakes and increase the confidence of the public. Francis J. Straub, New Kensington, Pa., was elected president unanimously; other officers are: 1st vice president, Raymond M. Weeks, Philadelphia; 2nd vice president, Henry Boettcher, Lancaster, Pa.; secretary, J. Edwin Rutter, Cameron & Reily Sts., Harrisburg, Pa.; treasurer, G. Edgar Allen, New York city; and the board of directors is as follows:

Howard Brooke, Bergen Building Block Co., 26 Bergen St., Englewood, N. J.; G. Edgar Allen, Brooklyn Crozite Brick Corp., 120 W. 42nd St., New York city; Charles P. Minning, Cinder Block Corp., Kate Ave. & Western Maryland R. R., Baltimore; L. A. Goodwin, Concrete Specialties Co., Mt. Ephraim Ave, N. of Grant Ave., Camden, N. J.; Alfred Owen Crozier, Crozier-Straub, Inc., 120 W. 42nd St., New York city; W. T. Black, Fairmont Wall Plaster Co., Fairmont, W. Va.; J. Edwin Rutter, Harrisburg Bldg. Block Co., Cameron & Reily Sts., Harrisburg, Pa.; Dr. R. B. Klotz, Hollywood Building Block Co., North Plymouth St., Allentown, Pa.; W. H. Blackwood, Hudson Fireproof Block Co., Homestead, North Bergen, N. J.; Henry Boettcher, Lancaster Concrete Tile Co., 228-34 North Water St., Lancaster, Pa.; Earl S. Philips, Musselman-Philips Corp., 13th & Thatcher Sts., Wilmington, Del.; Raymond M. Weeks, Penn Building Block Co., Inc., 923 Sansom St., Philadelphia; George E. Cantrell, Phila. Partition & Building Block Co., 1205 Real Estate Trust Bldg., Philadelphia; F. S. Moran, Straub Block Co., Taylor & Mill Sts., New Castle, Pa.; Francis J. Straub, Straub Patented Block Co., Warren, Ohio; Wallace R. Harris, Straub Fireproof Block Co., Forrest Park, Ill.; C. C. Spahr, York Patent Building Blox Co., Corner Chestnut St. & P. R. R., York, Pa.

English Architects and Concrete Design

By FREDERICK RINGS

WESTMINSTER, ENGLAND

Reinforced concrete construction has made great progress in England during the last 20 years and with the rapid recovery of trade has most brilliant prospects. The designing of this work was originally almost entirely in the hands of steel merchants who specialized in deformed reinforcing bars such as the Kahnbar, the indented bar, Clinton mesh, etc., almost wholly of American origin.

These firms prepared the designs and supplied the steel, the work being carried out by building contractors. The designing fee was included in the lump sum prices these steel firms obtained.

That method has not proved satisfactory to the architect, owing to the divided responsibility and furthermore to the fact that if the designer was in competition with others, he would overstress his steel to secure the contract or, if not in competition, he would put more steel in the work than necessary. Consequently certain specialists took up the designing on purely professional lines, employing mild steel rounds obtainable in the open market and acting for the architect direct for a fee which usually is 5% on the cost of the work.

Owing to the war and the consequent high cost of building, the architects found it difficult to justify the additional fee and this led gradually to the establishment of the reinforced concrete contractor who designs and carries out the work, thus taking the whole of the responsibility, and this method is certain to become permanent.

It is well known that practically no architect in England is trained to design this class of work, nor is it likely ever to form part of the architect's duty.

Arlington Building Floor Tests

By Louis J. Larson and Serge N. Petrenko

Abstracted from Technologic Paper No. 236 in *U. S. Bureau of Standards Notes*

The hollow tile and reinforced concrete floors of the Arlington Building, Washington, D. C., were loaded and the deformations measured. This was, at the time, the first test upon this type of construction in which strain-gage measurements were taken.

The floor slab was formed by rows of hollow tiles spaced 4 in. in each direction. The reinforcing steel was placed in these spaces and concrete poured around it and into the open ends of the tiles.

The columns are steel H-sections surrounded by a thick casing of concrete. The beams and girders have steel I-beams encased in concrete. These beams are generally near the bottom and may be considered the tension reinforcement.

The building, intended for a hotel, was originally designed for a live load of 75 lbs. per sq. ft. On account of the purchase by the government for an office building the live load was increased to 100 lbs. per sq. ft. and to care for this additional load a 2-in. layer of concrete was placed on top of the tiles. This type of construction was new in many respects and the design was considerably lighter than that recommended by the "Joint Committee on Concrete and Reinforced Concrete." For these reasons, it was desired to find the live load which could be placed on the floor panels before too high stresses were developed. It was desired, also, to secure as much information as possible on the action of the hollow tile slab.

The panels, having various ratios of length to width (from 1.05 to 1.86) were loaded with sand bags, separated by aisles to prevent arching, some up to 380 lbs. per sq. ft. The loading schedule was intended to produce maximum positive and maximum negative moments and to enable the study of the effect of transferring load to an adjacent panel.

The deformation readings consisted of strain-gage measurements on the steel and concrete and deflection measurements on the slabs and on the beams. The gage lines were located at positions of maximum positive and maximum negative moment and in some panels in other places to study the distribution of bending moments throughout the panel. The deflection readings were taken at the center of each panel and at the middle of the supporting beams. The corrections made necessary by the considerable fluctuations of temperature were based on readings on standard bars.

The maximum stresses developed in the slab were about 27,500 lbs. per sq. in. in the negative reinforcement and 24,000 lbs. per sq. in. in the positive reinforcement. Both stresses were developed at the load of 335 lbs. per sq. ft. The stresses developed in the reinforcing I-beams of the girders were lower. The maximum recorded compressive stress in the concrete was about 1,600 lbs. per sq. in.

The distribution of the cracks in the concrete furnished an indication of the distribution of the stresses at an early stage of the test. The first cracks observed were diagonal ones on the bottom of the slab. They occurred at about the same time as the cracks on the top which extended across the corners and at right angles to those on the bottom. The cracking of the concrete was accompanied by a considerable increase of the stresses in the reinforcing steel. The study of the cracks and the stresses shows that in a test of this kind, the deformations, though measured at positions of maximum moment, will fall far short of showing the maximum stresses unless the gage lines are located across, or very close to, the principle cracks. Thus, in some cases, the stresses observed at positions of maximum moment and at the gage lines crossed by cracks were 16,000 and 23,000 lbs. per sq. in., while stresses in gage lines 12 in. from the cracks were 4,000 and 5,000 lbs. per sq. in. respectively.

The effect of time under load was very pronounced in the first 20 hrs. and comparatively small later.

The effect of increasing the ratio of the length to the width of the panel was to increase the moments carried by the positive and the negative reinforcement in the short span and a corresponding decrease of the moments in the long span.

The beams offered very little resistance to torsion and the stresses in the negative reinforcement across the beam were little affected by the transfer of load across the beam.

The increase of the deformation in the reinforcement due to long-continued loading was greater than that in the concrete. This probably was partly due to the assistance of the clay tiles in resisting the compressive deformation because of the clay tiles yielding less than the concrete.

The moment coefficients are generally small due to the low stresses and are not proposed for use in design but to show the relative amount of bending moment carried in the two directions.

From the comparison of these results with those obtained from tests of simple beams, it appears that the factor of safety of the construction is apparently higher than 2.

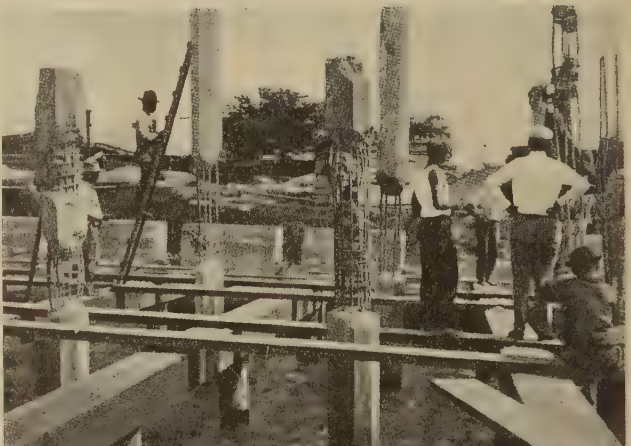


Fig. 1—Cutting Reinforced Concrete Piles at the Desired Level with the Aid of Dynamite

Cutting Concrete Piles With Dynamite

By Lieut. Commander S. Gordon (C. E. C.) U. S. N.

Since in the construction of a reinforced concrete wharf at the Pearl Harbor Naval Station, the depth to which the concrete piling would sink could only be determined roughly beforehand, it was not surprising that the driven piles should come to refusal with the butts approximately seven feet above the desired level. The writer, having noticed the clean break made by dynamite when used to cut off timber piles below the mud line, decided to try this method for cutting off the concrete piles. After exploding a stick of 60% dynamite in a 1-in. horizontal hole cored at the butt of a test pile, the shattered concrete was cut away, the surface smoothed with carborundum, tests for cleavage made on the concrete with magnifying glass and hammer, and the reinforcing rods subjected to bending tests.

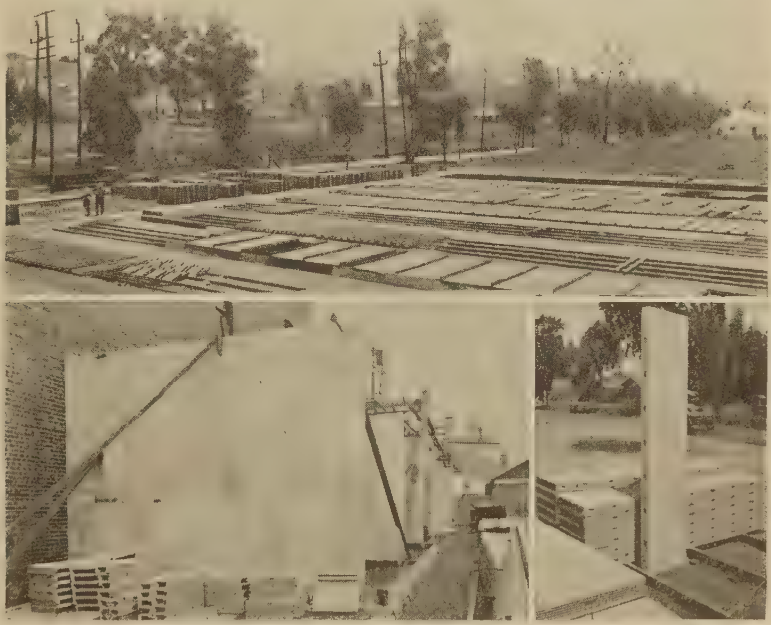
As both concrete and rods were found undamaged, holes were then cored around the butts of the remaining piles, which were shot in batteries of eight. This method enabled the whole piling to be sheared in a remarkably short time, and in no case was the disruptive damage found to extend beyond 18 in. from the center of the charge. By bending the exposed reinforcing rods into the beams to be carried by them, an excellent bond between piling and superstructure was obtained. That the wharf foundations were not weakened by the shots was shown after completion of the wharf when the damage done by a 250-ton coal barge, in capsizing alongside, extended no further than a small area of shattered deck, which could be repaired at a nominal cost and did not in any way affect either the beams or the piling.—*The Explosives Engineer*

Concrete Lumber in Los Angeles

The accompanying pictures show something of the operations of the Concrete Lumber Co., Los Angeles, Calif.

The concrete lumber product is chiefly in channel-shaped units of a number of sizes but of light section—standard units ranging from 6 in. to 24 in. wide and in lengths up to 8 ft. 6 in. Most of the units have a uniform thickness of 1⅛ in. The flange of each channel piece forms half a stud as erected. Longitudinal edges have a tongue and groove joint to avoid open cracks, and the stud flanges are provided with uniformly spaced holes for bolting.

To erect a wall, the slabs are set on end, with the stud projections along the two edges extending inward. The horizontal-running joints are broken, and the slabs are then secured in position by bolting through the holes in the studding. The projections, when thus united, form about 3- x 4-in. studs on 2-ft. centers. The wall is anchored at the base by means of bolts also, and, wherever rendered necessary, with a certain amount of grouting. For finishing the interior, vertical wood strips are first fastened to the inside surface of the studs by driving the nails into the slightly corrugated joints, and the lath, whatever its kind, is then nailed to these strips, after which the plastering is applied. The exterior of the wall is, of course, ordinarily finished with cement-stucco.



Manufacture and Use of Concrete Lumber

Twenty years of progress in the uses of concrete include a great many important developments which will be reviewed by leaders in various branches of the work at the Twentieth Annual Convention of the American Concrete Institute in Chicago, February 25-28.

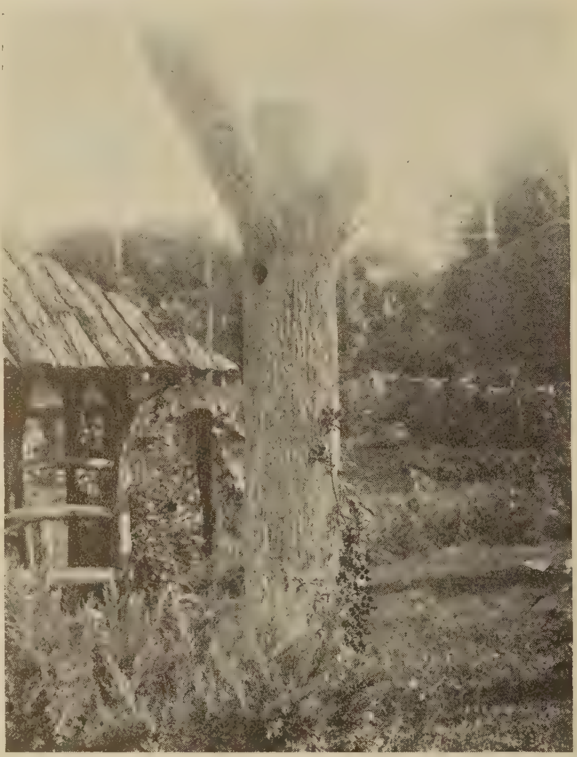
Products Manufacturers Exhibit at Fair

WISCONSIN
CONCRETE PRODUCTS
ASSOCIATION
AN ORGANIZATION TO IMPROVE THE QUALITY OF CONCRETE PRODUCTS & EXTEND THEIR USES

The photograph shows the exhibit of the Wisconsin Concrete Products Association at the recent Wisconsin State Fair. It was made to convey but one thought to the public: that concrete block stucco-covered walls are dry. A small Evinrude power pump pumped forced water over the wall continually for the six days of the Fair. The water was evenly distributed over the wall by means of a pipe with ⅛-in. holes in it, the water shooting through the holes with considerable pressure and running down the wall.

The exhibitors were a bit apprehensive as to the success of the demonstration because while the wall was to have been erected at least 28 days before the water was turned on, the man who took charge of erecting the wall was taken sick and did not notify others. It was discovered two days before the Fair opened that he was just putting the wall in place. The block were taken from the stock of Yunker Brothers, Milwaukee concrete products manufacturers, and were laid up the Friday preceding the Fair. On Saturday, two coats of portland cement stucco were applied. On Monday morning, the motor was connected up and the water started flowing. This miniature rain storm continued during the week, and on Saturday night when the exhibit was closed, not a trace of dampness was present on the inside of the wall. The exhibit was a success from the standpoint of attracting crowds, as there were many people present at all times looking at the wall and inquiring about a house plan service which was featured along with the other part of the exhibit.

A Concrete Tree Stump



This, gentlemen, is a concrete tree stump (the vine, we understand, is real). It would represent utter disaster to the woodpeckers if it were not for the forethought of its maker in providing ready-made holes leading to comfortable avian living quarters inside.

Seriously though (that is, as seriously as possible), this tree or tree stump is the work of Dr. B. H. Warren, 220 West Market Street, Westchester, Pa. It was fashioned of concrete over roofing paper, wood, bricks, and other odds and ends to form a number of bird houses, which appear in the ends of the top of the limbs of the concrete tree.

Dr. Warren was once State Ornithologist for Pennsylvania and knows the habits of birds better than most people; he has some very interesting ideas that he has applied in various ways, but this tree stump idea is one that he has worked out and in his yard has proved that birds which will inhabit man-made boxes appreciate the permanence, stability and fire-resistive qualities of concrete. Several pipes were assembled and tied together with wire, and the bottom was filled with brick bats, to hold them together as a base; the roofing paper was rolled securely around the pipes and the outside covered with chicken wire. Over the wire and paper the concrete was laid on, and rubbed smooth, after which Dr. Warren went over the surface with a nail and laid out the bark design. So that's that.

CONCRETE SAFETY

A FEW short years ago the flood waters from the Sierra Madre Mountains constantly menaced the city of Los Angeles and threatened the fertile farm lands adjacent.

THE necessity of flood controls was apparent and the Devil's Gate Dam came into existence.

THE engineers who built Devil's Gate Dam realized that not only must it be safe enough, but also that it was imperative that it be permanently safe and certain.

SO, naturally, the dam was built of concrete.

ASSOCIATED CONCRETE INDUSTRIES of Southern California

Associated Concrete Industries of Southern California

The Associated Concrete Industries of Southern California has been formed as an outgrowth of the Concrete Products Association of Southern California, the members of the earlier organization having realized the greater advancement possible in an organization which would unite a greater number of men and corporations in a mutual effort for the promotion of the quality and the public's acceptance of concrete. Twelve branches of the industry are brought together. Officers elected to serve until a new fiscal year begins January 1, next, are as follows: president, R. E. Johnston, of Glendale, president of the Concrete Brick & Tile Co.; vice president, M. G. Watkins, president of the Los Angeles Concrete Tile Co.; secretary-treasurer, Harley Wadsworth, of Los Angeles.

"There are many reasons behind this move," writes Mr. Watkins, "chief among them being the fact that we are seeking a greater leverage in the concrete industry in this part of the country. We realize that this could only be accomplished through the alliance of all those interested in the making of concrete.

"You will also note that we have divided our membership into many branches, in fact twelve: art stone; brick, face and common; building tile and block; cement manufacturers, hollow wall construction, precast and monolithic; machinery and equipment; material dealers; pavement contractors; pipe, drain tile and conduits; reinforced concrete; the Portland Cement Association considered separately from the cement producers as individual manufacturers; and miscellaneous covering all concrete work not specified in the above divisions. I do not intend to convey the idea that the Concrete Products Association was in any sense a failure; in fact it proved to be quite the reverse, starting with but a handful in February of 1922, and our recent meeting had an attendance of between fifty and sixty men interested in the industry, but we are now getting the support of other important lines, contractors, aggregate producers and others.

"We are arranging for a prominent display room in the heart of Los Angeles, and will employ in the near future a man as secretary and field manager to represent the organization throughout Southern California. Our dues have been changed to five dollars per month with an associate membership open to individuals connected with member companies at the rate of three dollars per year. You can appreciate the ultimate result of a cooperative body such as this now is. We are proving up exceptionally well in this territory, and where three years ago concrete products were virtually 'taboo' in this field, they are now recognized by the architects and builders throughout the territory.

"We do not permit price discussion at any of our meetings. Our association stresses one point, 'quality,' in all its activities, and it has been conclusively proved here that where quality is given the attention it should have in making of *everything* concrete there is little difficulty in obtaining a legitimate price.

"In connection with our other work, we are at this time with the assistance of the local cement companies (five in number), putting on a series of advertisements, educational in design, reaching out to the public through our daily press with information regarding the use of concrete in its various places." (One of these ads. is shown here.)

The American Construction Council

Unity in the construction field through local building congresses; apprenticeship, vocational guidance and craftsmanship; reduction of unemployment, were outstanding topics of discussion at the first annual meeting of the American Construction Council (following organization in Washington in June, 1922) held in New York city, September 21 and 22.

A note of welcome from President Franklin D. Roosevelt, expressing his faith in the usefulness of the Council, in its field of constructive activity for the future, was read by Vice President John E. Lloyd of Philadelphia. The Executive Vice President, D. Knickerbacker Boyd, was general chairman. Executive Secretary Dwight L. Hoopingarner transmitted to the meeting the regrets of Secretary of Commerce, Herbert Hoover, at his inability to be present, and messages of appreciation and support from others who found it impossible to be present. Mr. Boyd made an address, reiterating the purposes for which the Council had been formed and the major lines of activity along which it should operate.

The organization and operations of building construction congresses in New York city, Boston, New Jersey, Philadelphia and Portland, Ore. were given special attention by Harry T. Stephens, president of the New Jersey Building Congress, Richard A. Wolff, secretary of the New York Building Congress, James M. Gauld, vice president of the Boston Building Congress, and Col. F. M. Gunby of the Boston Building Congress, with letters and papers from others.

Apprenticeship, vocational guidance and craftsmanship, received concrete presentation by Fred F. Moran, managing director of the Apprenticeship Commission of the New York Building Congress; Dr. J. C. Wright, director of the Federal Board for Vocational Education; George Dautel, chairman of the Apprenticeship Committee for Bricklayers, Cleveland, Ohio; James M. Gauld, vice president of the Boston Building Congress; Col. F. M. Gunby of the Boston Building Congress, and others.

Reduction of unemployment in the construction industry received attention through a paper by A. P. Greensfelder, vice president of the Associated General Contractors of America, St. Louis, and an address by Dr. John M. Gries, Chief of the Division of Building and Housing of the U. S. Department of Commerce.

In each case there was open discussion from the floor participated in by numerous other persons, and the appropriate committee of the Council itself made announcement as to the activities and plans of the Council for action along the respective lines, among which was the report of F. W. Walker, chairman of the American Construction Council's Committee on Apprenticeship, Vocational Guidance and Craftsmanship, and the report of D. Knickerbacker Boyd, chairman of the American Construction Council's Committee on Seasonal Unemployment.

An evening session was devoted to "What the American Construction Council Can Do To Help the Various Branches of the Construction Industry." This was participated in by presidents or other representatives of about twenty or more organizations interested in the construction industry, who set forth the problems confronting their branches of the industry on which the American Construction Council can render help.

Resolutions were passed at the annual meeting of the Board of Governors, held in conjunction with the meeting of the Council itself, as follows:

Construction Congress

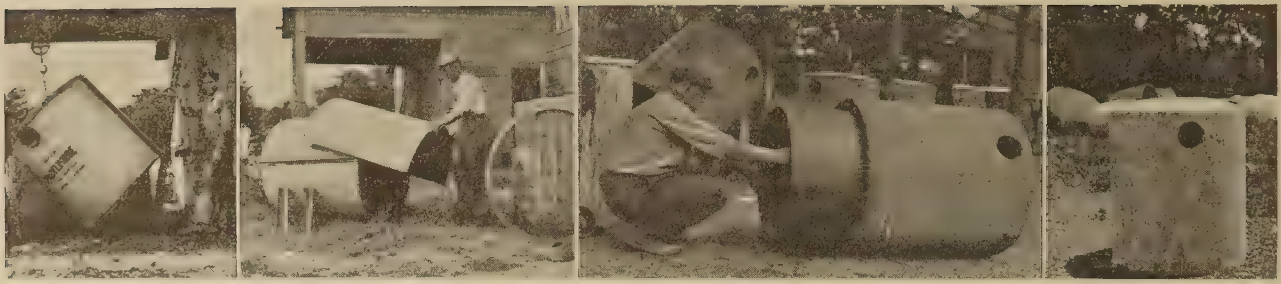
Recognizing the need of promoting the organization of local building construction congresses throughout the various construction centers of the country where none already exist and with the desire to cooperate in every appropriate manner with such congresses as already exist and to assist in the establishment of others, the Board of Governors of the American Construction Council herewith authorizes the expenditure of such sum as may be available up to $25,000.00, to be used in the promotion of this work; and the Board requests the officers of the Council to utilize its administrative resources in every way possible in the furtherance of this program.

Apprenticeship

With the desire of furthering a sound and adequate program on apprentice training for the construction industry and of cooperating in every way possible with the present bodies who are directing their efforts in this field, and who are or in the future may be inaugurating and conducting agencies for such training, the Board of Governors of the American Construction Council hereby requests the officers of the Council operating especially through its Committee on Apprenticeship, Vocational Guidance, and Craftsmanship, to cooperate with employees' and employers' organizations, building congresses, and all other elements in the construction industry, and with the educational bodies, local and national, in providing for apprenticeship which will be attractive to young men and will afford the fullest means for the employment and training of efficient workers as apprentices, and will produce the skilled workmen needed in the construction industry; and the Board further authorizes as the first essential step in this program the making of a national survey on apprenticeship needs and conditions of labor supply throughout the construction industry and through the appropriate agencies of the Council cooperating with all organizations within the industry.

Statistical Program

As to securing at regular intervals adequate data that would give the public information which it could use as a barometer of present and anticipated volume of construction by important districts throughout the country, and thereby level up the peaks and valleys in construction activities, the Board of Governors of the American Construction Council decided to defer action by the Council itself on a general program in this regard until such time as may be practicable, without duplication of effort, in expediting the collection, interpretation, and dissemination nationally of data applicable locally and at present not readily available to the general public.



Figs. 1-4—De Lhorbe Septic Tank Manufacturing Operations

Making De Lhorbe Septic Tanks

The De Lhorbe septic tanks (William De Lhorbe, Oregon, Ill.) shown in the accompanying illustrations are made of reinforced concrete units. The units are cylindrical, open at the bottom and domed over at the top, but having a cover in the dome which is sealed on installation in such a way as to make removal possible for the clean-out that is necessary at long intervals.

They are cast in steel molds, outside and in, the operations of turning and stripping being shown in the pictures. The units are of various sizes to meet the requirements of different installations, which are usually in batteries of three to get the proper septic action. When installed the units are set open end over on a floor of fresh concrete in an excavation of required size, the pipe connections being carefully sealed.

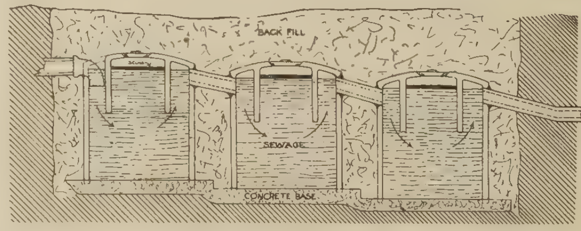
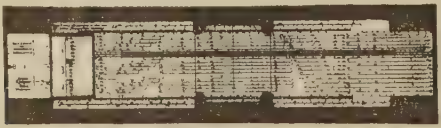


Fig. 5—Sectional View Showing How DeLhorbe Tanks Are Installed

A good business is being built up in their manufacture and sale in several localities from California to Massachusetts, as there is an increasing demand for hygienic sewage disposal in rural and suburban districts.

Slide Rule for Computing Concrete Designs

A logarithmic slide rule for the calculating of reinforced concrete structures is shortly to be introduced into the United States by Prof. J. Rieger, according to a notice received from the inventor. Professor Rieger is a roads and bridge engineer and is also connected with the Polytechnic high school of Brno, Czecho-Slovakia.



The rule is designed as a precise help for calculating concrete structures of any kind. It is stated that all problems about normal stresses in sections of any kind, rectangular and ribbed sections with single or double reinforcement, may be handled with the widest range of variations in the data and the results. It is an aid in computing single compression stresses, bending and direct stress and also in arithmetical operations such as multiplication, division, squares, square roots, etc. It is claimed that with this rule an engineer will be able to prepare rapidly and economically in his office large numbers of designs of bridges, factories, houses, etc. On the works he will be able to check in a few minutes the strength and suitability of design and to make rapidly any alterations which may be found necessary and without risk of affecting the strength of the work.

The rule is described as being 15 in. long, 3¼ in. wide and containing two slides and one frame on which more than 500 scales, which represent nearly 6,000 results, are inscribed with the greatest precision.

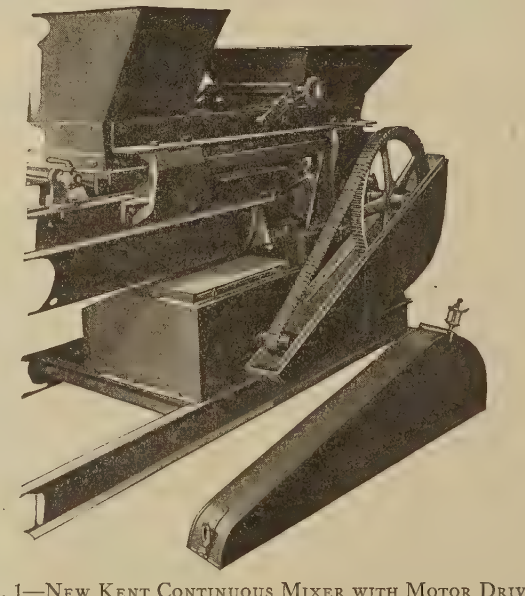
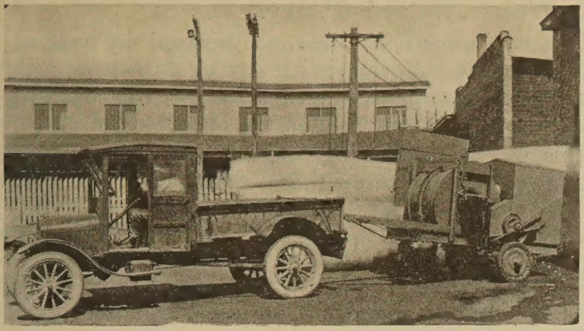


Fig. 1—New Kent Continuous Mixer with Motor Drive

New Kent Continuous Mixer

A new design of Kent continuous mixer, Kent Machine Co., Kent, Ohio, is built with either pulley or motor drive. When the motor is attached, a motor base is placed on the channels supporting the machine, and a silent chain drive is employed to drive up to the shaft upon which the pulleys are located when the pulley drive is employed. This is shown in the accompanying illustration.

This is known as the No. 3½ machine and is built with two or three hoppers and with either belt or motor drive. The machine weighs, complete with pulley drive, 4350 lbs. and with motor drive 4700 lbs. A General Electric 7½ H. P. motor is employed where the motor drive is used and pulleys 36 in. in diameter with 6½-in. face are used for the belt drive machine.



The Universal Concrete Mixer Designed to be Towed as Fast as a Truck Can Go

New Trailer Mounting for Mixer

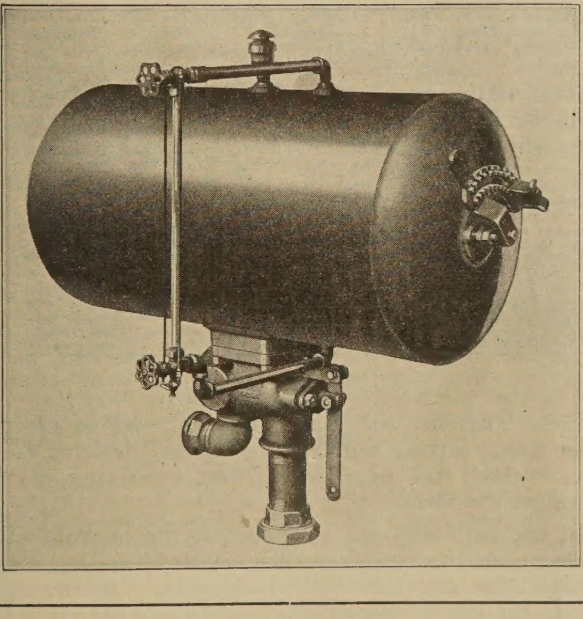
The Marsh-Capron Co., Chicago, Ill., has developed a trailer mounting for a concrete mixer which can be sold at a reasonable price and also is easy to move on the job. This Universal mixer with trailer mounting can be towed behind a truck at 25 or 30 miles an hour—95% of the vibration is eliminated by the large springs which carry the rear axle.

When the mixer is towed, the swivel castor at the front end is clear off the ground. But on the job this double-wheeled castor provides practically the same bearing surface as ordinary steel wheels, and the mixer is moved around easier than on an ordinary four-wheel mounting.

New Smith Water Measuring Tank

The new water measuring tank, designed by the T. L. Smith Co., of Milwaukee, Wis., for use on its concrete mixers, has an open-top trough, pivotted at both ends within the water-tight outer shell of the tank.

With the trough in an upright position, the operator first allows water to run into the tank until it is full. Then, as soon as he is ready, he opens the valve at the bottom of the tank and allows the water to run out of the tank into the mixer drum. But the water that is held in the trough cannot run out. The amount of water that does run out is equal to the tank full less the amount held in the trough. Tilting the trough so that it will retain less water permits more water to flow from the tank. When the trough is tilted to a position where it will no longer hold any water, the entire capacity of the tank can be drawn off.



A short arm at the end of the tank enables the operator to set the trough in the position that will allow just the right amount of water to be drawn off for each batch. A graduated sector, along which this arm rotates, indicates the amount of water being used. A lock is provided to lock the arm at any point along the sector if desired.

The water enters and empties from the tank through a 2½-in. valve located at the bottom of the tank.

Light Electric Surfacer

Electric surfacing equipment having a flexible shaft and a grinding head recently put on the market by the Campbell Machine Co., Wollaston, Mass., is particularly adapted to use on cast stone and to cut down form marks. The machine is equipped with ¼ h. p. motor, 25 ft. of electric cord and attachments. It has 3 speeds, namely: 450, 900, 1350 r. p. m. On the end of the shaft any kind of a carborundum wheel may be attached. The weight of this machine is only 50 lbs. The handle can be put in a vice and the machine used to grind tools on the job.

Two New House Books

The Book of Building and Interior Decorating, 10 x 13, 104 pages and cover, edited by Reginald T. Townsend, Editor of *Country Life*, published by Doubleday, Page & Co., Garden City, N. Y. Articles have been selected from *Country Life* with a view to giving the reader some fundamental knowledge of both building and decorating, and to portraying the most recent developments in domestic architecture. Illustrations are numerous and attractive, showing country houses in the main; and there are articles on the cellar, the perfect guest room, preparation for building, roofing problems, small perfections in construction, foundation, pictures, furniture, textiles, metals, the garage, wall board, and closets.

* * *

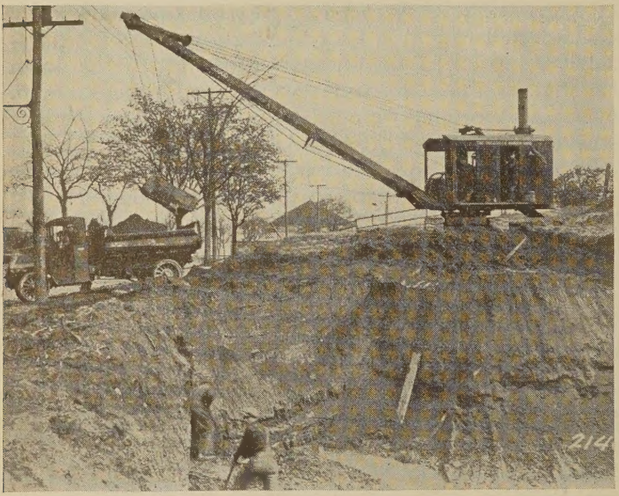
Homes of Moderate Size, by Kenneth W. Dalzell, arranged and edited by Edward F. Hammell, 9 x 12, 144 pages and cover, published by the U. P. C. Book Co. Inc., 243 W. 39th St., New York city; on a heavy, fine quality of paper, handsomely illustrated. The collection of photographs and plans of modern suburban and country homes, following the Colonial, Italian and English architectural styles, was made up on the basis of artistic merit and adaptability to the needs of the average American family, from the work of Mr. Dalzell.

Eugene Young, formerly secretary of the Minneapolis Builders Exchange, has been appointed secretary of the Associated General Contractors of America. Mr. Young was successful in organization work, and in dealing with labor problems in Minnesota, and as a monument to his executive ability he left the Builders Exchange a membership of 380, a modern 12-story office building, and a surplus in its treasury.

Unusual Sewer Excavation

The picture shows work on combined sanitary and storm water sewage system job by Booth & Flinn, Ltd., in 25th street, North Beach, for the Borough of Queens, City of New York. The section under construction consists of a concrete cut-off chamber, junction chamber, overflow chamber, and screen chamber, the latter equipped with two 14-ft. Rinsh Wurl revolving screens; together with 1250 ft. of reinforced concrete storm water sewer, 14 ft. 7 in. x 8 ft. 0 in.; and 1100 ft. of reinforced concrete sanitary sewer, 9 ft. 0 in. x 9 ft. 0 in.

The two sewers are located side by side and are being constructed in a single trench, excavated by open cut. The design provides a space of 3 ft. 8 in. between the two sewers so that, with sheeting and bracing, the trench is 35 ft. wide. The maximum depth is 38 ft., with an average depth of about 26 ft., and the material excavated is sandy clay on top with fine hard sand below, with the trench bottom from 5 to 7 ft. below high water.



Booth & Flinn Sewer Excavation Work, Borough of Queens, N. Y.

This work is located in an undeveloped section, 25th street being a proposed thoroughfare at this point, with ample room for casting the excavation on the trench bank. With this condition in mind, the contractors adopted a method of excavation that is seldom practiced in this section of the country, especially within the City of New York on sewage trench—that of the dragline excavator. For this purpose an Osgood ¾-yd. heavy duty dragline is being used, operated by steam power and equipped with a 45-ft. boom and a ¾-yd. Page dragline bucket. This dragline is fitted with continuous tread traction and rides on top of the cut and within the lines of excavation, somewhat to one side, and in operation drags the excavation in a circular fashion, with and across the cut. The material is loaded into motor trucks and between trucks is cast on the bank, well back from the cut. The excavation is cast only on one bank, the opposite one being kept clear for passage of a traveling derrick for use in excavating the trench bottom.

The dragline excavation is 40 ft. wide at the top, 35 ft. wide at the bottom, and digs from 13 to 21 ft. deep, depending on the stiffness of the soil, as the trench is not sheeted until after the dragline excavation has been made. This dragline has also been used in excavating, with a drag bucket, for the bottom in the sheeted sections, in sand and water, working between the bracing. The average progress has been about 350 yds., in place, for an 8-hr. day.

The two sewers are being concreted by means of Blaw-Knox steel forms, with a traveling mixer plant located on top of the trench, while the backfill is placed from the cast spoil on the opposite bank.

This work is under the direction of Frank Perrine, Engineer of Sewers for the Borough of Queens, and M. L. Quinn, general superintendent for Booth & Flinn, Ltd., and William Griff, resident superintendent.

Ames Lettering Instrument

The accompanying illustration shows the Ames lettering instrument and its various applications. This instrument, manufactured by the O. A. Olsen Mfg. Co., Ames, Ia., is recommended for use in reducing the time consumed in placing guide lines on drawings when lettering titles and notes. The device consists of a nickel plated tempered steel frame which retains a transparent celluloid disk that may be swiveled in the frame. The disc has three parallel rows of tapered holes which furnish a means for quickly drawing guide lines without the necessity of first locating them by means of a scale.

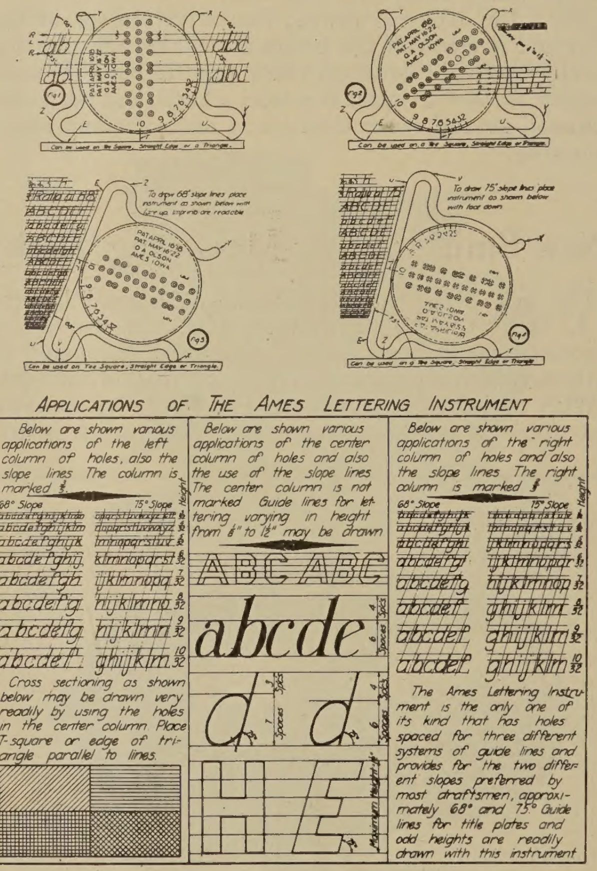


Fig. 1
Fig. 2
Fig. 3
Fig. 4
Can be used on Tee Square, Straight Edge or Triangle.
To draw 68° slope lines place instrument as shown below with O-r up. Imprints are readable
To draw 75° slope lines place instrument as shown below with foot down.
68° Slope
75° Slope
Height
ABC ABC
abcde
Spaces
Maximum Height

APPLICATIONS OF THE AMES LETTERING INSTRUMENT

Below are shown various applications of the left column of holes, also the slope lines The column is marked $\frac{3}{5}$.

Below are shown various applications of the center column of holes and also the use of the slope lines The center column is not marked Guide lines for lettering varying in height from $\frac{1}{8}$" to $1\frac{1}{2}$" may be drawn

Below are shown various applications of the right column of holes and also the slope lines The right column is marked $\frac{2}{3}$

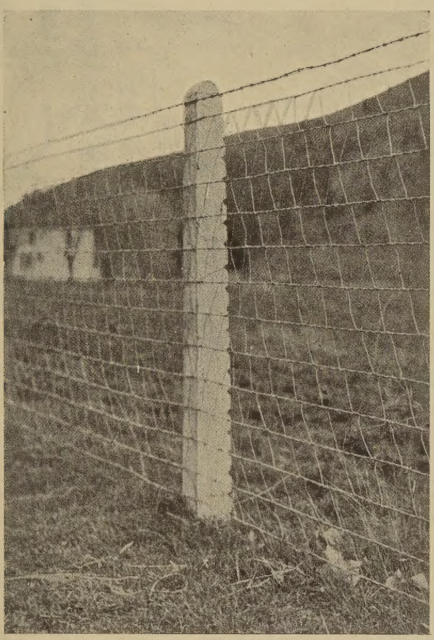
Cross sectioning as shown below may be drawn very readily by using the holes in the center column Place T-square or edge of triangle parallel to lines.

The Ames Lettering Instrument is the only one of its kind that has holes spaced for three different systems of guide lines and provides for the two different slopes preferred by most draftsmen, approximately 68° and 75° Guide lines for title plates and odd heights are readily drawn with this instrument

In use in laying out guide lines, the instrument is placed with the base in contact with the T-square or straightedge and then pulled alternately to the right and to the left by means of a pencil point placed in the holes of the disc, the pencil being shifted from one hole to the next after each movement to and fro. The vertical height between the guide lines may be regulated by swiveling the disc in the frame.

Serrated Concrete Fence Post

The advantages of neatness and permanence for fence posts which concrete possesses over other materials are well recognized, and while perhaps not many farmers feel that they can go to the expense of providing them, the concrete post does find its place on a large number of farms. One drawback which usually accompanies the use of this material—the lack of suitable fasteners for fencing— appears to have been overcome in the post illustrated, which is in use on a southeastern Washington farm. Ordinarily the fencing is supported by wires or nails imbedded in the concrete, and too often these are broken off by frequent bending.



This post, however, has a serrated inner face which supports wire wraps, these in turn supporting the fence material. The wire cannot be pushed down from the top by horses nor up from the bottom by hogs, and it may be held tight against the post in as many different places as the builder desires. The result is a fence which once in position, will need neither tightening not repair for many years. The post may be used to support either single wires or woven materials.

Trade Publications

The Invincible Concrete Block Machine, catalog of The Pettyjohn Co., 601 North Sixth St., Terre Haute, Ind.; listing and describing completely the operation of Pettyjohn block-making and stone-making equipment, in 16-, 18-,20-, 24-, 32-, 40- and 48-in. units. The Pettyjohn equipment is for use in making block face up or face down. The advantage is that the cores are withdrawn vertically, so that a slightly wetter mixture may be used than in tamp equipment with which the cores withdraw horizontally.

Koehring Heavy Duty Pavers is the title of Catlog No. 24 of the Koehring Co., Milwaukee, Wis.; 48 pages and cover, very handsomely gotten up in paper, illustrations and typography. It describes in detail the parts and operations of this line of pavers, with illustrations of the equipment on the job, together with detailed specifications.

Keystone Excavator, The Keystone Driller Co., Beaver Falls, Pa. 40 pages with paper covers, 8½ in. x 11 in. describing and illustrating the Keystone Excavator, Model 4, and the various jobs to which it is adaptable. Complete specifications and directions for operating are also included.

The T. L. Smith Co., Milwaukee, Wis., is distributing a small folder descriptive of two of the Smith line of concrete mixers—the new 4-S Tilter (half-bag) and the 7-S Non-Tilting mixer (full-bag). Special reference is made to the newly designed and much simplified device which is now used on the 7-S for operating the discharge chute.

Half-Bag Tilting Mixer, a descriptive pamphlet on the Smith 4-S Half-bag Tilting mixer has just been issued by the T. L. Smith Company, Milwaukee. In addition to pointing out the several features which are unusual in a machine of this small size, there are views of both the two-wheel and the four-wheel style, showing these mixers on some of the many jobs for which they are well adapted.

The Link-Belt portable conveyor is the subject matter of literature being sent out by the Link-Belt Co., Chicago, as to the use of this equipment in meeting the present coal situation. It points out the need for summer storage of coal to take care of winter's usage.

Parlock—Plastering, Cork Insulation, Waterproofing, Dampproofing—specifications, its uses, how it is applied, what it accomplishes, materials used, who applies it—an 8 page publication, 8½ x 11 in., of the Vortex Manufacturing Co., Cleveland, Ohio.

Blaw-Knox Single Line Buckets—16 pp. 7¾ x 10¾ in., Blaw-Knox Co., Farmers Bank Bldg., Pittsburgh, Pa., with descriptions, detailed specifications and numerous illustrations of single line bucket equipment for numerous classes of service.

Anchor Brand Colors for Mortar, Cement and Brick, C. K. Williams & Co., Easton, Pa. This booklet is about mortar colors, the best grades for various results, and some information as to proportions. While these manufacturers do not recommend them, they nevertheless report proportions of various colors to use with cement in getting certain results, based upon the experience of some manufacturers. As high as 20 lbs. of color to 100 lbs. of cement is specified for some of the colors. Good practice in the concrete field is to restrict the use of mineral colors, where a strong concrete is required, to not more than 10 lbs. of color to 100 lbs. of cement. Some specifications keep the color down to 5%.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

of Concrete, published monthly at Detroit, Michigan, for October 1, 1923.

State of Michigan,— } ss.
County of Wayne,— }

Before me, a Notary Public, in and for the State and County aforesaid, personally appeared R. Marshall, who, having been duly sworn according to law, deposes and says that he is the General Manager of Concrete, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and, if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 443, Postal Laws and Regulations, printed on the reverse side of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor and business managers are:

Publisher—Concrete-Cement Age Pub. Co., Detroit, Mich.
President—R. Marshall, Detroit, Mich.
Managing Editor—Harvey Whipple, Detroit, Mich.
General Manager—R. Marshall, Detroit, Mich.

2. That the owners are (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock):

Concrete-Cement Age Pub. Co., 1807 E. Grand Blvd., Detroit, Mich.
R. Marshall, 1807 E. Grand Blvd., Detroit, Mich.
Harvey Whipple, 1807 E. Grand Blvd., Detroit, Mich.
F. F. Lincoln, Room 1205, 115 Broadway, New York city.
R. N. Jackson, 1807 E. Grand Blvd., Detroit, Mich.
R. W. Lesley, Pennsylvania Bldg., Philadelphia, Pa.
Edward B. Bruce, Manila, P. I.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholders or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest, direct or indirect, in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers, during the six months preceding the date shown above is———. (This information is required from daily publications only.)

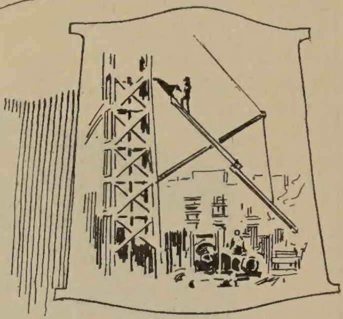
R. MARSHALL,
Manager.

Sworn to and subscribed to before me this 28th day of Sept., 1923.

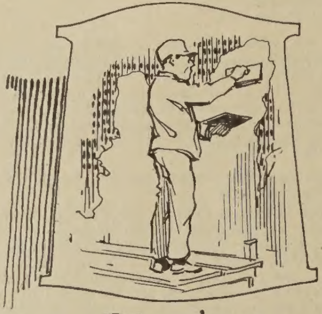
(Seal.) PERSIS E. HILL.

(My commission expires August 18, 1924.)

LIME


Concrete

Mortar


Plaster

Stucco

in construction